Canada. Dept. of Communications.

Telecommunication Studies. 1971.

5a – 5g.

POLICY CONSIDERATIONS WITH RESPECT TO COMPUTER UTILITIES

TELECOMMISSION STUDIES 5(a), 5(c), 5(d), and 5(e)

Available by mail from Information Canada, Ottawa,
and at the following Information Canada bookshops:

HALIFAX
1735 Barrington Street

MONTREAL
1182 St. Catherine Street West

OTTAWA
171 Slater Street

TORONTO
221 Yonge Street

WINNIPEG
393 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

Price $3.50 Catalogue No. Co41-1/5 A,C,D,E

Price subject to change without notice

Information Canada
Ottawa, 1971

The Importance of the Computer Utility

During the decade of the 1960's, the previously disparate technologies of computers and communications came together to create an important new class of combined computer/communications systems. Such systems, often called "computer utilities", are defined more precisely in Part I. These systems employ telecommunications links and a variety of equipment and time-sharing* techniques to make available directly to customers in their own premises a wide range of information and data-processing services. The system overhead is shared among all users, with each paying a service charge that varies with the use made of the system. Ideally, the utility should be able to provide each user, whenever he needs it, with the equivalent of a private computer capability responsive to his immediate needs, but at a fraction of the cost of an individually owned system.

The application of such systems, however, extends far beyond the field of computation. For in addition to making computer power available in a convenient economical form a computer utility can be concerned with almost any service or function that can in some way be related to the processing, storage, collection and distribution of information. As a result, at least within the technically advanced nations, computer utilities could eventually make the computer as much a part of everyday life as the telephone is today. Indeed many authorities predict that the computer services industry, by the end of this decade, will become one of the three largest in the nation. Out of this widespread availability of computer, or more correctly "information" power, there could flow social changes and opportunities for human development that promise to make the next few decades among the most critical that mankind has ever faced. Consequently, Canadians are faced now with many fundamental problems of law and public policy whose proper resolution is of vital importance to the future of our country and to the life-style of each citizen. These include the optimum means for ensuring equitable access to the benefits of computer power to the widest possible number of citizens and industries wherever located, the question of foreign ownership of a vital Canadian industry, the kinds of systems and services that should be built in Canada and the institutions and policies that are needed to encourage and guide their growth.

*Definitions of technical terms used in this paper are contained both in the text where appropriate and in the glossary of terms.

All of these questions can be summarized in the form of the following fundamental policy question: "How can Canada best exploit the computer utility concept to make the potentially revolutionary benefits of computer power available to the entire public and at the same time provide effective safeguards against the misuse of that power?"

It is the purpose of this report to assist the process of policy determination by illuminating the many dimensions of this fundamental question and examining the major policies and actions that have been proposed for dealing with it.

Related Telecommission Studies

The importance of the subject of computer utilities was recognized in the organization of the Telecommission and in particular in the studies of Section 5 - "Information and Data Systems".

Thus Section 5 is comprised of the following studies:

5 (a) The relationships between common carriers, computing companies, and information and data systems.

5 (b) Computers and privacy.

5 (c) Concept of a computer utility.

5 (d) Long-term market prospects for computer services.

5 (e) Telecommunications services; present and anticipated needs of the computer industry and its customers.

5 (f) Institutional arrangements for optimizing the development of data banks in the public interest.

5 (g) Problems in data transfer with particular regard to visual data.

Because of the close interdependence of their subject matter, it was decided early in the course of the Telecommission work to combine studies 5(a), 5(c), 5(d) and 5(e) into a single comprehensive report and this report represents the result of that combination. In addition this report also draws heavily upon the results of many other Telecommission studies whose work has a bearing on certain aspects of the computer utility, although it does not, of course, replace their specialized reports. Studies 5(b) and 5(f) fall in this category, as do many of the studies in Section I "Legal Considerations". Studies 8(b) and 8(d), which are concerned with the vital issues of "interconnection" and the future of "wide band" cable systems respectively, also provided a great deal of relevant material. Finally, Section VI "The Telecommunications Environment", dealing as it does with subjects

like "The Wired City" and "Access to Information" touches directly upon the social implications of many of the systems embraced by the term "Computer Utility".

Other Related Activities

In addition to the previously mentioned Telecommission studies a number of other special studies were performed in order to provide basic data for this report. The most important of these concerned the possible role of the Telecommunications Carriers in Public Data Processing and a special report* containing the results of this study was tabled in Parliament in June 1970. The report, entitled "Communications Canada - Participation by Telecommunications Carriers in Public Data Processing", was an attempt to provide objective background material for a full public discussion of the issues surrounding this complex subject. In this objective, the report was quite successful for, since publication, there have been extensive discussions in the press and the Department of Communications has received a number of thoughtful, well argued briefs from organizations representing both the telecommunications carriers and the independent data-processing industry. The contents of these briefs were of great assistance in the preparation of this report.

Additional public contributions were received in response to two questionnaires that were mailed to interested parties in the Canadian Communications and Computer Industries and to major users of computers and communications. The first contained a general set of questions designed to test public opinion concerning basic policy towards computers and communications and was mailed to a broad spectrum of different organizations. It, together with the results, is described in Appendix A. The second questionnaire was developed jointly with the Candian Information Processing Society and was intended to provide a picture of the current status and plans of those companies involved in supplying remote data processing services in Canada; consequently it was sent only to commercial suppliers of such services. Its results are summarized in Appendix B.

Appendix C contains the results of another important study. Entitled "The Economics of Integration: Telecommunications Companies and Data Processors" it was prepared by Prof D. Cowan and Prof L. Waverman of Waterloo and Toronto Universities respectively: and represents a preliminary attempt to evaluate the many factors involved in the difficult question, "What are the economies of integration, if any, when computer and communications functions are combined within a single organization?"

* The special report employed a great deal of material drawn directly from an earlier unpublished version of this more comprehensive Telecommision report. Consequently the reader will find considerable overlap and duplication between the two reports.

Three other important contracted studies also played a role in determining the content of this report even though they are not directly appended. These are:

A Forecast of Developments Within the Information Processing Industry in Canada; Lyman E. Richardson, T-Scan Limited. March 1970.

Relationships Between Telecommunication Carriers, Computer Service Companies and their Information and Data Systems; Richard W. Judy, Systems Research Group, Toronto. November 21, 1969.

Report to the Department of Communications on the Relationship Between Computer Service Companies and Common Carrier Telecommunication Organizations; Lyman E. Richardson, T-Scan Limited. December 1969.

Mention should also be made of the work of the Committee on Computer Applications and Technology of the Science Council of Canada. The Department of Communications and the Science Council Committee have freely shared information from their respective studies and there is basic agreement between the two organizations concerning the importance of the computer utility area. It is expected that the Science Council report will build upon the material in this document and recommend specific proposals for action to the Federal Government.

This importance was also emphasized by the Canadian Cabinet when, in its decision of October 1970, it directed the Department of Communications to create a Computer/Communications Task Force to expand upon the work of the Telecommission and prepare concrete plans for an "Integrated Network of Canadian Computer Utilities" designed to bring the benefits of computer power to all Canadians wherever they may live. A detailed description of this Task Force will be found in Appendix E .

Part I

Classification and Basic Concepts

The Sharing of Computer Power

Computer utilities are a new class of resource sharing systems by which a complex commodity called "computer power" is shared in a convenient and economical manner among many geographically distributed customers. These new systems differ fundamentally from the normal computer service bureau in that the services are supplied directly to the user without requiring the physical transportation of data between the customer and the central processors. The data transportation, instead, is performed over communications links, and it is for this reason that the term "tele-data processing system", i.e. combined communications and data processing system, is often used to describe the sorts of systems with which we are concerned.

Computer utilities also differ significantly from other resource sharing systems in the fact that computer power, or more correctly "information power", is a much more complex commodity than, for example, electric power or telephone service. In it are contained elements of mathematics, of information retrieval, of communications in all of its myriad forms, of publishing, and of human and machine actions and interactions. Its definition involves complex combinations of such factors as : time, computation rates, instruction repertoires, data and procedure bases, peripheral equipment characteristic and usages, and communications speeds, capacities and access times. Figure 1 is an attempt to portray something of this complexity. Computer utilities also differ from traditional utilities in that they currently operate in a competitive environment in which a number of firms may offer similar services in the same territory.

Basic Computer Utility Categories

As might be expected with such a complex commodity, the systems employed in the distribution of computer power can take many different forms. These can be categorized on a functional, operating mode, or institutional basis as follows:

Functional

Special Purpose - This is the oldest form and is exemplified by the familiar reservation and stock quotation systems. In it, the central processor is restricted to the performance of a single function or a group of related tasks specified in advance by the system designer.

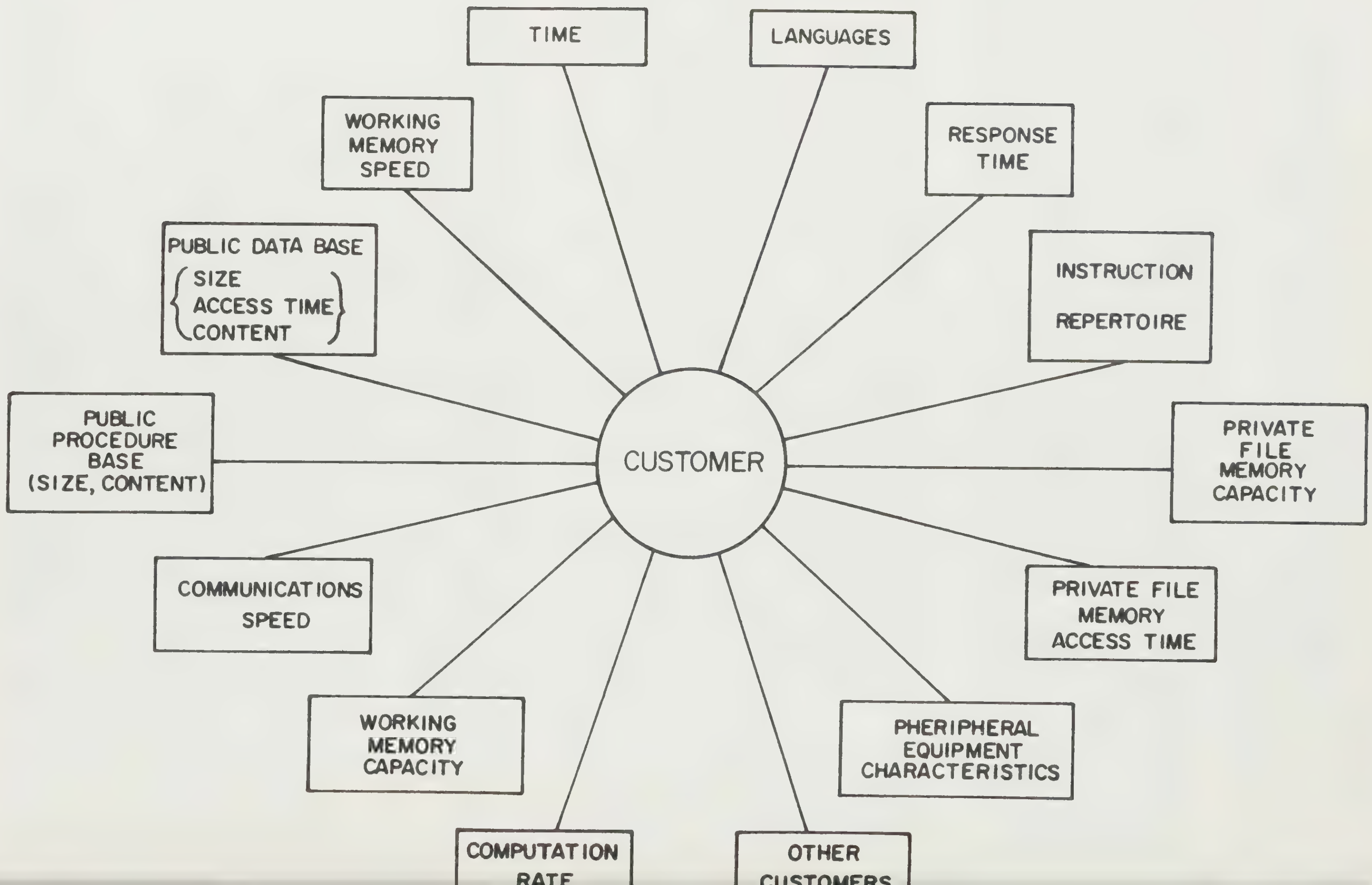
General Purpose - These are systems which can handle many different kinds of tasks; i.e. in the limit, any task for which a digital computer program can be written. In general, these tasks will not have been specified by or be known to the system designer.

Operating Mode

Batch Oriented - In such systems, each customer's programs are handled on a queuing or scheduled basis; i.e. completing customer A's work before going to customer B, etc. The operation here is similar to that in a normal service

FIGURE 1

THE MANY DIMENSIONS OF COMPUTER POWER



bureau batch processor operating under the control of an "Operating System", except of course for the fact that the data and programs are transmitted directly between the users and the computer over communications lines. The term "Remote Batch Processing" is often used to describe this type of operation.

Responsive or Time-Shared - The phrase "responsive" here carries the connotation of immediate access or "real time" operation and it is made economically feasible through a technique known as time sharing. In a time shared system, many customers are served at the same time with the computer switching from customer to customer at a rate that is short in comparison to a typical human response time. Each user's program is thus run in the form of short bursts or quanta of computation so that all programs are multiplexed together in a continuously repeating cycle. Ideally the length of this cycle is short enough so that any single customer at a remote console is unaware of the intermittent nature of his service and feels that he is the sole user of the system.

Mixed Systems - Many systems operate in a mixed on-line and batch mode, where on-line service for problems up to a certain size or of a critical priority is provided, but other problems are run on a batch basis in the "background".

Institutional

Private - These are systems whose use is restricted to members of the owning organization.

Public - It is these systems which have generated the greatest popular interest and led to the use of the term "Computer Public Utility". As the term implies, they supply computer power to many different customers outside of the owning organization.

Combinations of Forms

These different forms can be combined in many different ways. For example, we can have private general purpose systems like those in use in hundreds of organizations today, private special purpose systems such as those used by individual airlines for reservation purposes, public special purpose systems, public and private multiple purpose systems, and a whole hierarchy of increasingly complex general purpose public systems which, in the limit, could encompass the entire computing power of the nation.

Basic Functional Elements

In all of these different categories of Computer Utility, three functionally distinct elements can be identified. They are:

(a) The basic computer facilities including the "Central Hardware", the "Executive System" and various Compilers and Access Control Programs. These facilities are sometimes called "raw computer power".

(b) The telecommunications system which links the computer facilities to the remote users and which may also include the terminals on the customers' premises.

(c) The services provided by the utility, e.g. payroll, inventory control, information storage and retrieval, invoice generation, etc. These are based upon data and programs, termed "application software" that is stored in the computer facilities and serves to organize those facilities as necessary so that they can perform useful work.

Within the facilities or "raw computer power" area, the term "Central Hardware" could include such elements as mass storage systems - core, drum, disk, video tape etc; working memory; data processing units; input/output buffers and control equipment; and in certain cases also switching facilities, modems and data multiplexors. The "Executive System" comprises both hardware and software and is responsible for coordinating and controlling the overall operation of the computer utility. It is therefore responsible for the control of functions like scheduling, swapping, memory protection and look ahead, and may also perform certain bookkeeping and data conversion tasks. Large "Compilers" like FORTRAN, COBOL, APL, etc. are special programs which make it possible for a computer to accept a set of instructions written in non-machine language and produce as an output a machine language program in which many of the original instructions are replaced by complex sequences of machine instructions called subroutines Such programs as well as the special Access Control Programs employed in the control of the"information retrieval" process in a "data bank" application seem to fall naturally into the category of raw computer power since the same programs may be used for an almost unlimited number of applications.

Business Categories

These functional elements provide a basis for categorizing the many different types of businesses that exist or might exist within the Computer Utility Industry.

(a) Supplier of Remote Computer Services

This type of business operates centralized information processing centers and makes raw computer power available via remote terminals directly to the customers on their own premises. In addition most organizations that supply this type of service (i.e. IBM, GE, SDL, Computel) also provide a host of special application programs. Some also perform certain secondary communications functions like line concentration and message preprocessing. Further, the computer utility may handle the

leasing arrangements for communications circuits for its customers.

(b) Integrated Supplier of Special Services

The KEYDATA Corporation, represented in Canada by AGT Limited, the Credit Data Corporation and Bunker Ramo Corporation are good examples of this type of business. As in the Remote Computer Service case, the companies in this category own and operate information processing centers. They differ, however, in that instead of supplying raw computer power, they provide special services to their customers who, in general, are not provided with a capability for performing their own programming. The services are made possible by special packaged programs tailored to the performance of specific business functions. Thus, in the case of AGT's KEYDATA services, these functions include invoicing, credit checking, inventory control, customer analysis and special report generation while for Bunker Ramo, the functions are those concerned with the operations of brokerage houses.

(c) Purveyor of Raw Computer Power

Since the term "raw computer power" refers to the facilities portion of a computer utility, a Purveyor of Raw Computer Power is one who offers the use of such facilities. Such an organization represents a sub-class of the "Supplier of Remote Computer Services" category in that it does supply raw computer power but does not supply application programs other than the previously mentioned compilers and information retrieval control programs.

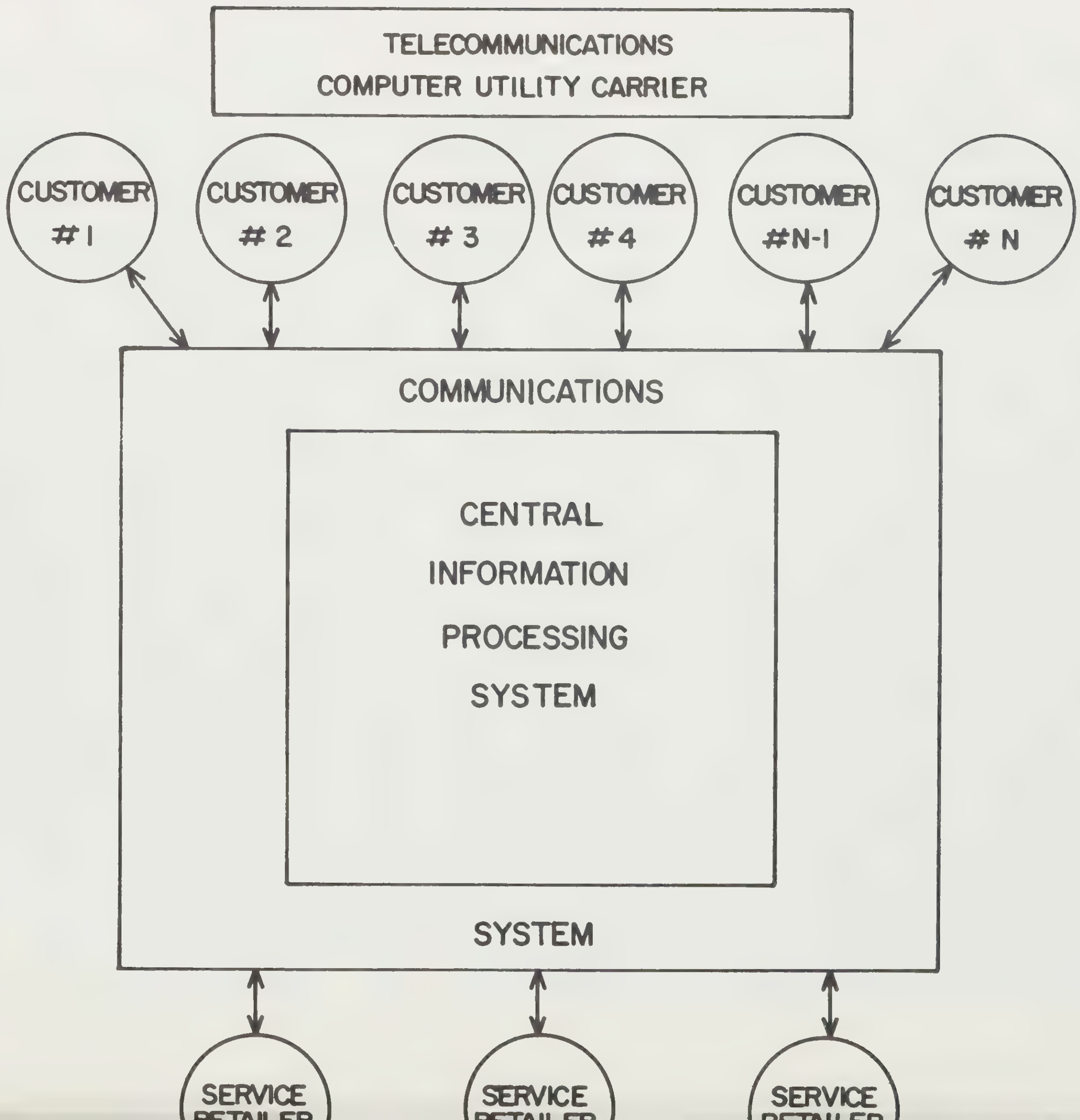
(d) Telecommunications/Computer Utility Carrier

In a computer utility, there may be valid technical reasons, especially when the switching and data conversion aspects are considered, for combining many of the communications and data-processing functions. This leads to the concept of a hybrid organization that could supply both "raw computer power" and telecommunications but not Application Services. In this report, such an organization is called a "Telecommunications/Computer Utility Carrier", and it is illustrated in Figure 2.

(e) Independent Service Retailer

The concept of a Purveyor of Raw Computer Power implies the complementary concept of a purveyor of processed power or, as it is called in this report, an "Independent Service Retailer". Instead of owning or renting computers, these organizations would rent memory capacity and processing capability; i.e. "raw computer power" from a Raw Computer Power Purveyor, fill the rented memory space with their own and their customers' proprietary data and programs, and then retail their services to their remote customers through the facilities provided by the telecommunications carriers and the Purveyors of Raw Computer Power. In other words,

FIGURE 2


TELECOMMUNICATIONS
COMPUTER UTILITY CARRIER
CUSTOMER #1
CUSTOMER # 2
CUSTOMER # 3
CUSTOMER #4
CUSTOMER #N-1
CUSTOMER # N
COMMUNICATIONS
CENTRAL
INFORMATION
PROCESSING
SYSTEM
SYSTEM
SERVICE
SERVICE
SERVICE

the Service Retailer provides the same services as the Supplier of Remote Computer Services but utilizes other organizations' facilities for their distribution.

This concept of the "Service Retailer" is as old as the concept of the computer utility and was originally suggested by Prof. John McCarthy of Stanford University at the MIT Centennial in 1961 where he introduced the term "cottage computing" to denote the activities that this report associates with the Independent Service Retailer. Despite this, to date, such organizations have not evolved to any significant degree but it can be argued that, with proper encouragement, they could be the instrument for a dramatic growth of the application services industry. If this were to happen, one would eventually expect to find a multitude of different organizations represented in this category. They could include private companies, foundations, governments, educational and charitable institutions and even individuals.

(f) Total Computer Utility

As an alternative to the sort of functional segmentation of the industry implied by the preceding categories, it is also possible to envisage an integration of application services, communications and computer power in integrated monolithic companies that operate as "Total Computer Utilities". In fact, even today in the United States (Western Union) one finds a single organization proposing to engage in every facet of the Computer Utility business so that it will be able to provide its customers with any desired mix of raw computer power, data transmission and switching, and application services. Likewise, in the United Kingdom, the British Post Office has similar plans.

PART II

Applications

The general technical advances that have made possible the Information Utility can be briefly summarized as follows:

1. It is now technically feasible to bring the full power of a large-scale computer complex to anyone in the world who is served by suitable telecommunications facilities.

2. The interaction between the central computers and the remote user is essentially instantaneous so that the user receives service that is indistinguishable from that which he could receive if he were physically present in the same room as the computer.

3. The cost to each user is but a small fraction of what it would be if the same services were provided by individually owned computers.

4. Each subscriber can be provided with expandable, rapidly accessible private files that are reasonably well protected against unauthorized access.

5. The intellectual achievements and data collections of many individuals and groups can be pooled in large public files so that their contents become simultaneously available on demand to all customers of the system.

6. The technique of time sharing has made direct dialogue between man and computer economically practical.

7. Techniques of man-computer interaction have been developed that permit true partnerships between men and machines so that the special capabilities of each are blended together in a harmonious whole. These techniques have been successfully applied to many fields including engineering design, information retrieval, medical diagnosis, problem solving and computer programming.

This combination of advances makes possible a broad range of applications that were previously impossible for technical or economic reasons. In fact even today the range covers all of those tasks for which conventional computers are normally employed in addition to a host of others which only become feasible through the multi-user features. Consequently any complete list would be prohibitively large. On the other hand the general boundaries of the major application areas, insofar as these can be gauged at this early stage in the evolution of computer utilities, can be visualized by lumping the different applications together under suitable headings in a logical classification scheme. One such scheme that has been found useful employs six basic categories.

1. Reference Services

The first commercial applications of the on-line - real time and time-shared modes of operation were those which involved access to a common data base by many remotely located users. Early applications included airline and railway reservation services, order tallying, and stock market quotation services. Today, the range of application is being further extended and specialized information networks are evolving for handling such diverse forms of information as police records, credit reports, medical and legal files, and scientific data of all kinds.

The evolution of such specialized networks is likely to continue as more and more of the myriad social and occupational groups of the modern community come to appreciate the advantages of remote access. Some of the broad categories of services that might be provided include:-

Professional	- legal, medical, law enforcement, scientific, engineering, pharmacy, agriculture, etc.
Business	- credit, real estate, marketing reports, regulations, prices, trade data, etc.
Consumer	- consumer testing and satisfaction reports, product specifications and prices, product availability, advertising, etc.
General Information	- political and economic data, historical, travel, weather, entertainment, etc.

These are further summarized in Figure 3.

It is obvious that these categories could be expanded indefinitely until, in the words of Robert Fano, the Director of Project MAC, information utilities become "the depository of the data base and information processing procedures of the community". This depository could, in the long run, draw upon and integrate the resources of all of the specialized utilities so that it becomes a gigantic electronic encyclopedia, continuously distilling the essence from our society and making it available at any desired level of concentration to everyone.

2. Financial Services

No aspect of direct access computer utilities has received more attention than their application to the world of finance. Some applications, those concerned with ready access to financial data are, of course, partially covered by the reference services category, but there are many others, and just as in the reference services case they are likely to lead to specialized networks. These might include:

FIGURE 3

REFERENCE SERVICES

- PROFESSIONAL
  - Legal
  - Medical
  - Law Enforcement
  - Scientific
  - Engineering/Architecture
  - Pharmacy
  - Agriculture
- BUSINESS
  - Credit
  - Real Estate
  - Sales Statistics
  - Marketing Reports
  - Key Personnel
  - Regulations
  - Prices
  - Product Sales Figures
  - Technical Trade Data
  - Production Figures
- CONSUMER
  - Consumer Testing
  - Consumer Satisfaction
  - Product Specs
  - Product Prices
  - Product Sales Figures
  - Warranty Information
  - Product Availability
  - Advertising
- GENERAL INFORMATION
  - Employment Data
  - Political Facts
  - Sports Statistics
  - Historical Data
  - Weather
  - Travel
  - Repair Information
  - Gardening

Investment Nets concerned with security transactions, market analysis services and stock service.

Insurance Nets capable not only of providing routine services to insurance companies but even of generating tailor-made policies on-line for individual customers.

Banking and Credit services. Both the banks and credit agencies have been particularly active in opening up the "Direct Access Age" and are currently heavily involved in such activities as the development of professional billing services; the provision of on-line teller terminals, sometimes integrated with management information services; and the establishment of banking and credit networks.

As a result of these and similar developments, it has been argued that in the near future, we will see the credit card idea merged with the concepts of computerized banking and credit bureaus to create a new type of universal financial utility whose customers will identify themselves by means of a universal credit card or "money key". As time goes on, this "money key" could replace both the cheque and most normal currency as a medium of exchange. In fact, in both America and Europe, key experiments aimed at exploring the possibilities of such automatic transactions are currently underway. These experiments could eventually lead to an integrated world-wide financial network that will permit a customer to make money key transactions anywhere in the world. The range of services offered could also grow to eventually encompass every type of financial transaction no matter how complex or trivial it might be.

If this happens, the Financial utility, illustrated in Figure 4, could have available within its files, a complete, immediately accessible electronic record of the current and past financial status of every customer from billion dollar corporation to school child. Bank balances, obligations, credit ratings, earnings (current, projected and past), data on all of these and more could be contained in the records. As a result, the flow of money between individuals, organizations, or even nations, could involve nothing more than an automatic transfer of information within the memory banks of the utility. In effect, all of the world's myriad financial institutions would have been integrated and transformed into a single vast electronic information system.

3. General Business Services

Both the financial and reference services applications are, of course, deeply involved with business in all of its aspects. Nevertheless, there are many other areas of business life that could profitably use the services of a direct access computer utility. Some of these have been lumped together under the broad heading of General Business Services and are shown in Figure 5.

FIGURE 4

FINANCIAL SERVICES

- INVESTMENT
  - Purchase and sale of Securities
  - Market Analysis
  - Stock Quotations
- INSURANCE
  - Shopping
  - Tailor Made Policies
  - Cost/Benefit Analysis
  - Premium Payment
  - Actuarial Calculations
  - Customer Statistics
- BANKING
  - Transfer of Funds
  - Automatic Bill Payment
  - Automatic Payroll Distribution
  - Loans
  - Overdraft
  - Instant Cash
  - Purchasing
- CREDIT
  - Credit Check
  - Tailored Loans
  - Loan Repayment
  - Credit Planning
- TAXATION
  - Calculation
  - Collection
  - Checking
  - Customs
  - Excise
  - Sales
  - Property
  - Assessment

FIGURE 5

GENERAL BUSINESS SERVICES

RETAIL & WHOLESALE PROCESSING

- Invoice Preparation
- Merchandise Management
- Credit Checking
- Point of Sale Recording
- Marketing

PRODUCTION CONTROL

- Scheduling
- Process Control
- Production Reporting
- Inventory Control
- Materials Management
- Resource Allocation
- Project Status Reports

PURCHASING

- Shopping
- Selling
- Ordering
- Payment
- Consumer Satisfaction Survey

PLANNING

- Sales Forecast
- Policy Selection
- System Evaluation
- Market Analysis
- Production Planning
- Investment Analysis
- Plant Layout
- Resource Allocation

MANAGEMENT INFORMATION

- Personnel
- Financial Reports
- Sales Reports
- Production Reports
- Inventory Status
- Market Situation

4. General Computation Services

Calculation in one form or another is, of course, interwoven with just about all of the applications that are discussed in the report. Likewise, many of the functions included under the heading of General Computation Services in Figure 6, have already appeared elsewhere, either as functions within a larger application category, or, as in the cases of reference data and planning, as major categories. Despite this, it was felt that the three major application categories shown: vis Design, Business Computation and Automated Laboratory Services, were sufficiently different from the applications that have been discussed hitherto to justify separate treatment.

5. Educational Services (See Figure 7)

Few areas of computer application hold greater long term promise than the field of education. In this connection, the three main areas of application shown in Figure 7 provide a convenient format for categorizing the thousands of possible uses. Of the three categories shown, the "Administrative Services" area is currently the most highly developed and both "stand alone" and remote access computers are in extensive use by school systems throughout the world. The "teaching" field has also received a great deal of attention and a number of experimental and pilot systems have been established, especially in the United States, to evaluate the many possible techniques and systems configurations. In fact one of the most important is currently being undertaken by NRC in cooperation with various provincial educational authorities. Widespread operational use of computer assisted instruction (CAI) even in the school environment, not to mention private homes, is however still some years away. Major obstacles at the moment include the high cost and crudity of program material; the high cost of terminals; central processor and communications costs and the need for extensive research and pilot experiments to determine the proper role of CAI in the teaching process.

The General Encyclopedia category, on the one hand is covered by the previously mentioned "reference services" group with the schools becoming both suppliers and customers in reference service networks. On the other hand, it tends to merge with computer assisted instruction so that the contents of the encyclopedia data banks can be drawn upon as necessary by the Instructional Systems and integrated with the programmed instruction material. Needless to say the latter type of operation has not to date moved out of the research laboratory. Computerized data banks ranging from specialized systems: medical, legal, technical etc., to general library services are however in use in many universities, although they do not appear so far to have invaded the secondary and elementary school systems.

6. Personal Services

A computer utility can provide many services to many users; it can also provide specific services to a single user. Indeed existing public systems already provide private storage facilities to which only the authorized user can have access. Such facilities can be provided to a user at his place of business for his private files, appointments calendar, and message storage, or at his home for a multitude of personal records from tax files to recipes and shopping lists.

FIGURE 6

GENERAL COMPUTATION SERVICES

- DESIGN
  - Calculation
  - Reference Data
  - Computer Graphics
  - Simulation
  - Engineering Vote Book
  - Cost Analysis
- BUSINESS COMPUTATION
  - General Financial
  - Planning
  - Calculation
  - Cost/Effectiveness Analysis
- AUTOMATED LABORATORY SERVICES
  - Calculation
  - Record Keeping
  - Data Reduction
  - Reference Data
  - Control of Experiments

FIGURE 7

EDUCATIONAL SERVICES

- ADMINISTRATIVE SERVICES
  - Record Storage
  - Curriculum generation
  - Marketing
  - Financial
  - Supply
  - Progress monitoring
  - Testing
  - Report Generation
- GENERAL ENVYCLOPEDIA
  - History
  - Mathematics
  - Language
  -
  -
  -
  -
  - Current Affairs
  - Art
  - Social
  - Sports
  - Trade Data
  -
- TEACHING
  - Drill & Practice
  - Tutorial
  - Dialogue
  - Generation of Teaching Programs
  - Game Playing
  - Simulation
  -
  -

Relation of Applications to System Characteristics

Earlier in this report, Figure 1 portrayed some of the many factors involved in a definition of "computer power". For any computer utility the relative importance of these factors and the ways in which they interact are, to a large extent, dependent upon the application that the system is designed to support. For example, if the application of the system is to be restricted to the single job of storing and retrieving information, then there will be no requirement for either a customer programming capability or for extensive computational capabilities at the central processor. Thus, both the organization of the central machines and their program structure can be optimized around the data manipulation and file searching problems. On the other hand, there may well be a need for storage of voluminous amounts of narrative and pictorial information in a rapidly searchable form and for its transmission to and reproduction at the user's console.

Again, if the application is basically a routine business processing one: invoice production, credit checking or inventory control, for example, then the full facilities of a General Purpose Business oriented computer will be required at the central station, but once more, there may be no need for user programming. Instead, an extensive library of packaged prewritten programming systems will be needed, each designed to handle a particular application for a whole industry, and hopefully, capable of satisfying with only minor modification the needs of many different customers. Many of the Financial, Educational Support and General Business Services applications fall into this category.

At the other extreme are the systems where customer programming is a major element in meeting the users' needs. In fact, as was mentioned earlier, the interactive operating mode which becomes economically feasible with time-sharing, is in itself, a major asset for the programmer. In such systems, most of the application programs are written by the users, and the only software provided by the system, apart from the executive, and possibly certain compilers, is that which is concerned with providing assistance in the programming process.

PART III

Promise VS Danger

The Promise

It should be apparent from the broad scope of the applications described in Part II that the information utility is destined to have a major impact upon our society. In fact, the social importance is implicit in the term "information power" for information is, in a very fundamental sense, the basic stuff of human society - the true élan vital, if you will, whose communication and application in a billion different forms makes us human. Consequently, quantum jumps in our ability to handle information are likely to be marked by fundamental changes in the nature and quality of society. Just such a transformation of information handling capability into social change happened 500 years ago with the development of moveable type. It will almost certainly happen again through the application of computer technology.

In this connection, the term "post industrial society" is now increasingly used to denote the new society towards which the most technologically advanced nations seem to be evolving. This society has been described as follows by J. Servan Schreiber in his book "The American Challenge.":

"Not only will it be a richer society, but a different kind of society since, beyond a certain level, wealth is measured not so much by a higher standard of living as a completely different way of life."

It has been suggested that the developments discussed in this report will play a central role in this new society. For, in the post industrial community just about every activity whether in the arts, sciences, industry, education or government could center around and, in fact, function through the ubiquitous computer networks. As a result, "the completely different way of life" promised by Schreiber could include services and capabilities that even today sound utopian and which only a few years ago would have been pure fantasy. Thus, some authorities see the emergence over the long term of:

(1) An Economy of Abundance, largely automated and integrated so that all of the myriad industrial, distribution and business functions would become in effect a single distributed machine, capable of turning out goods and services of a quality and in numbers that seem fantastic today.

(2) Individualized Computer Assisted Instruction providing each student with the equivalent of a private tutor embodying the best judgment and total experience of the world's greatest educators. Education thus might become a continuing process largely independent of age and geographical location; i.e. no one would even be further from the classroom than his local "fireside computer terminal". In the long run this could have a major impact upon the entire educational system. Both the form of the school and the role of the human teacher could undergo drastic changes as "fireside computer consoles", universal electronic encyclopedias, teaching utilities and academic administrative utilities come into widespread use. For one thing, the concepts of grades and of classes based on calendar age might have to be abandoned. In their place would be a system of independent tracks for each student. Progress along these tracks would be

continuous at a pace that would be separately controlled for each student, according to his individual performance. In fact, with the advent of domestic computer utility service, there is no reason why much of a student's instruction and study could not take place at home. The time at school could then be devoted to laboratory work, group discussions and seminars and individual consultations with the teachers.

(3) Automatic Publishing: Another area where computer utilities could bring about some interesting changes is the publishing business. An author, for example, might do his writing at the keyboard of his personal utility console. His product would take shape in his private files in the central computer and, to publish, he would simply notify the utility of the existence of his work and authorize its inclusion in the public files. Once in these files it would be freely accessible to all the other utility customers via the viewing screens of their own terminals. Utility fees, royalty payments and the like would be handled automatically, with a direct transfer of credits to the author's royalty account every time someone accessed his document. Similar arrangements could apply to every other type of creative work - newspapers, magazines, motion pictures, computer programs, data banks and so on.

(4) Decentralization: With the development of a "communications affluent" society in which the techniques of television, computer graphics, computerized data bases, data-processing and normal telecommunications were combined and their services made universally available via "fireside" terminals, many of the pressures for urbanization could be reversed. Some experts claim that if people could access and manipulate any piece of information without leaving their homes and simultaneously interact with other people and machines as easily as if they were sitting in the same room with them, then there would be little reason for concentrating workers in large office buildings. Just as we mentioned for education, they might better conduct their routine business activities from the comfort of their homes and gather together only for formal affairs, laboratory work and social occasions.

Eventually, with the production and distribution processes largely automated and with shopping, entertainment and business transpiring largely via telecommunications, predictions have been made that the need for people to live within easy commuting distance of their businesses, school or shopping facilities could also vanish. It might be possible for people to live in any part of the country and eventually the world and still partake fully of all of the social and economic amenities that we associate with urban life. A family, for example, might live on a mountain top in British Columbia even though the husband "worked" in Toronto, the son went to school in Halifax, the daughter in Montreal and the wife did her shopping in London, New Delhi and Paris.

(5) Universal Access to Knowledge: The reference services mentioned earlier eventually should provide universal access to the complete store of human knowledge. The contents of the Lenin Library, of the British Museum or the Library of Congress could be instantly accessible at every man's terminal whether he lives in Yellowknife or Toronto. Combined with the teaching utilities mentioned earlier, this universal access to information would be bound to profoundly modify our traditional educational values. What, for example, would be the value of those forms of education that are based upon the memorization of factual material, when every man could know any fact merely by approaching his fireside terminal?

(6) True Participatory Democracy: The national computer networks could provide a natural medium for increasing the direct participation of citizens in the political process. Beginning with electronic opinion sampling, extending next to electronic vote-taking in local elections and referenda, later to national elections, they could eventually permit everyone to vote directly on all major issues.

This list, of course, could be continued indefinitely but it does seem obvious that even if only a few of the possibilities mentioned come to pass, they will still vindicate Schreiber's prediction of a "completely different way of life". Within this way of life, there is a common thread that ties together all of the possibilities and constitutes the true promise of the computer utility. This is the promise not alone of change, for change can just as easily be bad as good, but rather of large scale improvements in the quality of life for everyone. Taken together, these improvements add up to an infinitely freer life than any to which human beings have ever before dared aspire - literally a life of limitless horizons in which human intelligence will be free to develop to its ultimate limits.

For Canada, many enthusiasts feel that these possibilities present us with what may be our supreme challenge. They suggest that, by aggressively and imaginatively exploiting the promise of the information utility, Canada could leap-frog decades of normal development and become among the world's first post-industrial societies. Within this new Canada, the universal availability of information power could magnify by orders of magnitude the economic and intellectual capabilities of our people and lift the nation in a gigantic quantum jump to an unprecedented level of achievement.

The Dangers

Unfortunately, there is also a darker side to the information utility and it requires little imagination to see some of the dangers that might face us if certain of its capabilities were to be misdirected. The same technical advances that promise so much in the way of a freer and more open society have dangerously magnified the power of both governments and private organizations to keep all of us under close surveillance and could easily be perverted into the instruments of total political control.

Together the various data files of the different networks - medical, educational, financial, legal, law enforcement, etc., could make available in a conveniently accessible form a complete record from birth until death of even the most private affairs of everyone. In the absence of adequate controls, this could create a dangerous menace to the right of privacy and, if carried far enough, to a society in which conformity would become the price of survival.

Even more serious are the problems of freedom of access and of censorship that will arise as information utilities replace the more orthodox media - newspapers, radio, television, etc., as methods of mass communication. We are all familiar with the enormous impact that television has had on our way of life and the ease with which unscrupulous interests and politicians can employ it to manipulate public opinion. But the impact of television is limited in comparison to that of a "total information system" in which the data manipulation and information storage capabilities of the computer could be combined with television in a sort of universal electronic oracle backed by the resources of a monopolistic enterprise or totalitarian state.

Potentially, the information utility could provide the rulers of a conformist state with the ultimate instrument for control of the minds and ideas of the people. Instead of faithfully preserving the infinite varieties of human thought, the files of the system would hold only that which the censors decided was good for the populace. History could be continuously rewritten, facts inserted or distorted, any material that questioned the status quo carefully excluded - all in the best Orwellian tradition - and horrible as this may seem - if the deception were carefully handled, no one would be aware that anything was wrong. Likewise even in a nominally democratic society, 1984 would not be far away if we were to permit any group, government or private, to manipulate the public files or to tap into an individual's private files without that individual's permission.

Fortunately, these dangers are for the moment only distant shadows from the future, but when set against the glittering promise described earlier in this chapter they do help to delineate the nature of the challenge that Canada faces in devising a viable policy with respect to computer utilities.

PART IV

Basic Considerations

In devising policies that will permit Canada to realize the promise of computer utilities and at the same time minimize the dangers that could arise from their misuse, there are a number of basic considerations that should be kept in mind. These include:

The Interdependence of Computers and Communications
The Importance of the Public Files
Technological Uncertainties
Impact on Canadian Sovereignty

Interdependence of Computers and Communications

In the computer utility, the normal boundaries between data-processing and communications become blurred. The primary reason for this blurring is the total dependence of remote access systems upon data transmission lines, but in addition many other important reasons have been advanced by both communications and data-processing interests:

(a) The computers required for the data-processing segment of a computer utility are perfectly capable of performing many "communications" functions that are normally regarded as being the prerogative of the communications carriers. Included here are functions like signalling, store and forward message switching, multiplexing and message concentration.

(b) The communications carriers employ and in many cases manufacture an enormous variety of digital equipment including special purpose computers. Thus, they possess an extensive body of knowledge and experience in digital technology that is potentially transferable to both the data-processing and communications segments of the computer utility.

(c) The optimum design of a computer utility demands a "systems approach" in which the emphasis is on the integration of functions like information transfer, storage, message switching, data compaction, computation, etc., rather than an arbitrary division into data-processing and communications segments.

(d) Some of the equipment employed by the carriers in the operation of their networks, it has been suggested, could be adapted to perform or assist certain data-processing tasks for their customers. The use of augmented automatic message accounting equipment to perform computer usage and billing for independent data-processing utilities as suggested in Part VI is a good example.

As a result of this interdependence of computers and communications, there has been a tendency for many data-processing firms to attempt to diversify into the communications area (Bunker Ramo, Control Data, University Computing, etc.) and for communications carriers, notably CN/CP Telecommunications in Canada and Western Union in the United States, to enter the field of data-processing. The fact that the communications carriers are regulated monopolies, while the data-processing industries are highly competitive and unregulated, complicates the resultant situation.

A further complication arises from the fact that the existing telephone networks and their associated rate structures were, with few exceptions, designed for voice rather than data services. Many remote access applications, however, are distinguished by very long holding times, (hours instead of minutes), but rather low line utilization factors. Traffic tends to flow in rapid bursts, with long intervals between the bursts, and may also be highly asymetric -- the computer to customer data flow normally being considerably higher than that from customer to computer. As a result, computer users would like to see the current time and distance tariffs replaced by a charge based upon the amount of data transferred, or alternatively to see the current connection times, (of the order of several seconds), and minimum holding times -- (minutes), reduced to milliseconds and seconds respectively.

Basic Policy Questions Concerning Carriers

The foregoing considerations lead to a number of basic policy questions concerning the future role of the telecommunications carriers in the computer utility field:

(a) Should telecommunications carriers be permitted to provide public data-processing services or should they be barred from the field?

(b) In the event that the carriers are permitted entry to the data-processing business, then:

  (1) What services will they be permitted to offer:

    (a) Only the use of their computer hardware; i.e., "raw computer power"?*

    (b) A full range of software services as well?

    (c) Certain other carefully defined and limited services?

* For definition see P. 8.

(2) Should such services be tariffed?

(3) Should such services be provided by the carrier itself - "horizontal"* diversification, or should they be offered through a separate corporate affiliate - "vertical"* diversification?

(c) Should data-processing and other organizations be permitted to establish specialized data communications networks or provide special communications services like third party switching or multiplexing in competition with the carriers? If the answer is yes, should the carriers be required to interconnect with these new networks, thereby allowing data-processing companies to use their switched facilities?

(d) How should "wide band" services as exemplified by video phone, high speed data transmission and the rapidly developing cable TV systems be handled. Should the cable systems, for example, be left as they are, or combined into a new regulated two way wide band network with an obligation to "supply all demands for services"?

If the latter, should new regulated carriers be created? Or should the CATV systems be absorbed by the existing telecommunications carriers?

The importance of these questions has evoked widespread interest on the part of both governments and industry and this interest has been reflected in a number of important recent events that are relevant to the subject matter of this report. These are:

1. In January, 1969, CN/CPT acquired a controlling interest in Computer Sciences Canada Limited and thus became the first Canadian telecommunications carrier to offer public data-processing. Quebec Telephone, a provincially regulated company affiliated with General Telephone and Electronics also offers public computational services. Other carriers, including Bell Canada, have expressed interest in entering the field.

2. Independent data-processing companies, in a brief to the government dated June 20, 1969, expressed concern about the entry of telecommunications carriers into the public data-processing business and requested that the government undertake a public enquiry.

3. Recent computer industry statements allege that, pending a clarification of the relationships between telecommunications carriers and public data-processing, the growth of the entire industry will be inhibited.

* For definition see P. 47

4. The F.C.C., in a notice of intended rule-making dated April 1, 1970, has proposed that U.S. telecommunications carriers, with the exception of AT&T,* be permitted, subject to a variety of constraints to offer public data-processing services. This opens up the prospect of subsidiaries of U.S. carriers; i.e., General Telephone, IT&T, Western Union, offering data-processing services in Canada while Canadian carriers are forbidden to do so.

5. In June 1970, the Minister of Communications tabled in Parliament, a special report entitled "Communications Canada - Participation by Telecommunications Carriers in Public Data-Processing". The report, which was in essence a summary of material from an earlier draft version of this Telecommission Report, was intended to provide objective background material for a full public discussion of the issues surrounding this complex subject.

6. In July, 1970** the F.C.C. served notice that it would entertain proposals for specialized data transmission networks intended to provide a variety of new services. As a result, the current AT&T and Western Union monopolies in interstate data transmission may be broken. If this does happen then a number of technologically advanced data transmission systems could come into existence between major centres in the United States. The low cost and versatility of the resultant services could further increase the disparity between Canadian and American telecommunications offerings and accelerate the tendency of Canadian users to utilize United States remote data-processing companies.

The Importance of the Public Files

The system of files in most multiple user systems, whether general purpose, special purpose, private or public, in general, constitutes one of the most basic and important features. These are of two types:

(1) Private

Where access is restricted to the authorized user or his designees.

* AT&T is barred because the services will not be regulated and, under the terms of a 1956 consent agreement, AT&T is not permitted to engage in unregulated businesses.

** F.C.C. Notice of Inquiry to Formulate Policy; Notice of Proposed Rule-Making and Order; Docket No. 18920; Adopted July 15, 1970; released July 17, 1970.

(2) Public

In many systems these files could represent the greatest single asset, for they would contain an ever increasing library of programs and data generated by many different users, but accessible to every customer. Since the resources and information possessed by these files would grow continuously as the system was used, they would represent at any instant in time, the integrated knowledge and intellectual resources of the users up to that time. Thus, they would provide an unprecedented capacity for the rapid dissemination of knowledge. The effective utilization of this capacity which could easily exceed the value of the physical plant, is one of the major challenges facing the designers and users of computer utilities as we enter the direct access age. If some, or all, of the data or routines in the public files were copyrighted, however, serious royalty problems would arise. Who should pay the royalties - the customer or the utility? If the former, should the utility be made responsible for their collection? If so, what collection fees should be charged?

Technological Uncertainties

The computer industry has been distinguished from its beginning by the presence of rapid technological change. Thus, in the twenty years that have passed since the first stored program computer became operational at Cambridge University, three distinct generations of computers have appeared and a fourth is now in the process of being born. For the policy planner, this dynamic characteristic introduces many complexities, for there is always the danger that, by the time a policy is implemented, technological change will have destroyed the assumptions upon which it was based. In particular, recent developments in the area of mini-computers, video recorders and communications technology could have a major impact upon the future of computer utilities.

Mini-Computers

The term 'mini-computers' is applied to a large class of low cost physically small, free standing general purpose computers which first achieved prominence in the mid 1960's. Since 1965, when the Digital Equipment Corporation introduced its PDP-8 machine at the then phenomenally low price of $18,000, there has been a rapid growth of the mini computer industry as both the older, well established computer corporations and dozens of aggresive new companies have rushed to exploit the miniaturization and cost reduction possibilities of solid state electronics.

"Large Scale Integration" (LSI), in particular has led to desk top machines costing less than $10,000 which provide a level of performance and an internal memory speed which would not have been available five years ago in computers costing twenty times as much. In fact, for

under $12,000 it is possible to obtain a computer* with a 300 nano second instruction execution time, 4096 words of 16 bit monolithic memory, teletype interface, and direct memory access data channel. Other machines are priced as low as $3,000 and many authorities predict that progress in LSI will eventually bring the price below $1,000.

Of equal importance, is the fact that mini-computers are now available with a host of "big machine" features including extensive software libraries; large compilers like ALGOL, FORTRAN IV, COBOL and BASIC; real time clocks; magnetic tape units; disk memories; card readers and printers; and even time sharing. Of course the inclusion of major items of peripheral equipment like disk memories and tape drums can rapidly multiply system costs to the point where the mini-computer proper represents only an insignificant fraction of the total system price. Indeed, as is discussed later in this chapter, mini-computers may well replace flip-flops and other logical elements as the basic building blocks of very large size multi-million dollar "super computers" for computer utilities.

Applications of mini-computers have proliferated at a rapid rate and now include process control in industrial plants; experiment monitoring, control and data collection; educational applications; computer aided design; terminal and communications control in time sharing networks; and a host of business and scientific data-processing functions. In fact, even at their current prices, these computers represent an attractive alternative to public time sharing services for many applications. Consequently, if the cost/performance ratio continues to fall and is not balanced by similar reductions in the figures for remote access systems, then a significant fraction of the computer utility market could be lost to the private machine.

Video Recorders and Play-Back Systems

During 1969 and 1970 the subject of "Electronic Video Recording" or EVR, received a great deal of attention as several promising new techniques opened up the possibility of low cost compact video recording and play-back equipment for educational and home use. There are at the present time at least four basically different, and incompatible systems in the early marketing or prototype stage of development and within the next two years it is expected that home systems capable of displaying good quality pictures on a TV set and retailing somewhere between $400 and $1000 will be widely available. The four basic techniques currently being promoted are:

CBS/EVR which employs tiny photographic images on low cost thin film stored in a plug in cartridge.

* The Data General "Supernova SC", price $11,900

Magnetic Tape Cartridge Systems such as those developed by AVCO and Sony and capable of recording programs as well as playing pre-recorded material.

RCA Selecta-Vision which uses laser beams and holographic recording techniques and promises both very low cost and high quality but is still several years from commercial production.

The Decca/Telefunken disk system in which special wide band width phonograph disks are used to store video data in an analogous manner to conventional audio recordings. In addition to low cost, this technique offers a number of significant advantages over cartridge systems for information retrieval applications.

If, as is generally expected, these systems, before the end of the decade, develop a truly mass market comparable to that enjoyed today by conventional television, then they are bound to have a dramatic impact upon the entire information industry. Video cartridges could well replace books for many purposes and except for a few restricted applications where live coverage is vital, conventional television could disappear. Instead, video cartridges would be sold, or rented from libraries the way books are handled today and, depending upon the relative costs of cartridges and communications, "demand" cable television systems could provide on line access to central stores of information and entertainment material. The latter development, however, is strongly dependent upon wide band communications costs, for if these remain too high, many data bank services may be better supplied by individual libraries of video cartridges, video playback equipment and mini computers for search and selection. In other words, people might buy their data banks from the corner drug store instead of subscribing to a public service.

Communications Advances

Development in communications, such as satellite technology, the use of digital modulation techniques and the development of economical wide band two way distribution systems could help counteract the impact of the private mini-computers and low cost mass data stores. Satellite technology in particular could ultimately have as great an impact on the future of information utilities as the perfection of time-sharing has had in bringing them to their present state. With communication satellites distance is no longer a significant factor in the cost of providing communications services. Further, since they eliminate the need for expensive ground relay networks, satellites are likely to be the least expensive means for providing mass communications in the less developed countries of the world. In fact, for areas like Northern Canada, Africa, India and Brazil, it may soon be possible to provide communications services of the most advanced type at a fraction of the cost of conventional systems. These could include not only high quality television, radio and telephone communications, but also a wide range of data transmission services. The first Canadian communications satellite "Anik" which will also be the world's first

geostationary domestic satellite is expected to begin to provide services in 1972. It will provide a total of twelve television band width channels, ten of which will normally be available with two held in reserve as spares.

In the international field the eight Intelsat 4 satellites now on order for the global network will each provide the equivalent of 5000 voice circuits in normal "area coverage operation" or 8500 circuits in the narrow beam operating mode. This capacity could be increased to 10,000 by providing for narrow beam operation on all 12 transponders instead of the 8 in the current version. In fact Hughes engineers estimate that relatively minor modifications such as the use of orthogonal polarization on high density routes could increase the capacity to 22,950 circuits. Finally, by the end of the decade, Intelsat engineers estimate that new larger satellites will provide up to 85,000 circuits.

The factor which is expected to have the greatest impact on communications satellites systems however is the provision of exclusive frequency bands for satellite use. In this connection, the forthcoming World Administrative Radio Conference, to be held in 1971, will review allocations for the various services and may allocate approximately 6 GHZ of bandwidth between 11.7 GHZ and 31 GHZ for exclusive satellite use. By removing ERP restrictions and eliminating interference from terrestrial microwave systems, such allocations could drastically reduce the size of earth terminals, and make it possible to eliminate the costly microwave tails between terminals and urban switching centers. This would result in major system cost reductions which could be reflected in a corresponding reduction in the cost of long distance data transmission.

With the elimination of distance as a significant communications cost factor, some tantalizing new prospects are opened up for the exploitation of the Information Utility concept. World-wide information networks have now become technically feasible and, with such networks, the vital commodity which we have termed "computer power" could be made available in any desired concentration everywhere on earth. A United Nations Information Utility, as the vehicle within which a multitude of international networks could develop and grow, could act as a gigantic electronic nervous system for the entire globe. In addition to enormously magnifying the operational effectiveness of the United Nations and its specialized agencies, such a system could leapfrog the knowledge barriers between the developed and underdeveloped areas of the world and ultimately bring the complete store of human knowledge within the reach of every human being.

Other new transmission techniques that could have a major impact on communications costs include: coaxial cable system in both individually switched and loop forms; waveguide systems currently capable of handling up to 280 M bits/sec but with a projected growth to 30,720 M bits/sec by the late 1980's and laser optic systems with

capacities in the million M bit/sec range. It is worth remarking also, that conventional twisted pair cable as used today for normal telephone service has a potential one way transmission capacity of 1.5 M bits/sec with repeaters spaced at 1.15 mile intervals. In fact if low capacitance paired cable (which still costs far less than coaxial cable) is used, rates as high as 6.3 M bits/sec with repeater intervals of 2-5 miles are possible.

Digital communication techniques also promise to significantly reduce communications costs in both terrestrial and satellite system. Thus Telecommission Study 4(a) "The Future of Communications Technology" has estimated that:

"a 10 station FM/FDMA system having a capacity of 450 one way voice channels could provide 900 channels if PCM/PSK/TDMA were used."

Other improvements could result from the incorporation of the previously mentioned mini-computers directly into the communications systems so that the switching functions are geographically distributed instead of being concentrated in large costly central exchanges. Such a development would further blur the boundaries between computers and communications.

The rapidly developing Cable TV services represent another area of technical uncertainty with important implications for the future of computer utilities. Originally intended to be no more than a means of bringing improved television reception to viewers in areas where reception was poor or choice of programs limited, Cable TV now promises to impact heavily upon the entire field of telecommunications. Multi-service wide band systems using coaxial cable, could for example provide viewers with an almost unlimited choice of programs including conventional television. In addition however they could also make possible an enormous range of new services, many of which would involve two-way communication. Information retrieval services, for example, could include wide-band transmissions of pictorial material to the subscribers via cable and the use of narrow-band channels in the same cable for subscribers' queries and responses to a central computer. The implications of such a facility for computer assisted instruction and services like computerized shopping are obvious.

At this time, however, there is no agreement as to either the optimum approach to wide band services or the best means for incorporating them into the sorts of systems with which we are concerned here.

Some authorities argue that the full exploitation of wide-band distribution systems in industry and the home requires that such systems be fully integrated into the communications common carrier networks with a requirement that the carriers be "required to meet all demands for service". Under this concept, television

channels, for example, would cease to be a scarce and, therefore, rationed commodity and would become instead readily available to anyone, without any requirement for government licensing, as a normal telecommunications offering. Under such conditions, one can, for example, imagine an explosive growth of pay TV with the customer having a choice of hundreds of programs. The growth of other wide-band services involving the previously mentioned two-way communication would, however, probably be of even greater significance. These could include thousands of new services, many of which would involve access to computerized data banks.

Others, on the other hand, argue that granting the carriers a monopoly of wide-band services would stifle innovation and slow down the development of the very services that it is so vital that we encourage. They propose instead that new carriers be formed through amalgamation and interconnection of the existing cable TV organizations and that these carriers be licensed to compete with the established carriers in providing a limited class of video services. Finally, some would perpetuate the present situation and regard cable companies merely as broadcasters, subject to the same restrictions and limitations as normal television stations.

Closely allied to the cable TV issue is the issue of separate dedicated digital networks. Many countries: Sweden, Great Britain and Germany are good examples; are constructing or planning systems for data transmission that are separate from the carrier voice networks. Likewise in the United States, the FCC has indicated its willingness to entertain requests from non-carrier organizations for licenses to construct and operate such specialized networks in competition with the regular carriers.

The technical and short term economic arguments advanced by proponents of such separation include such factors as:

- ability to provide faster signalling times, milliseconds instead of seconds.

- elimination of any need for costly modems.

- economical digital transmission techniques since only pulses rather than analog wave forms need be handled.

- elimination of adverse loading effects on the conventional switched voice networks.

- inherent compatibility with transaction oriented tariffs and short minimum holding times.

- lower error rates.

- greater reliability.

- etc.

On the other hand, there are also strong arguments against the concept. These, together with the pros and cons of a number of different policy alternatives are discussed in some detail in Part VII.

Systems Architecture

The whole question of optimum system architecture is one of the major technical uncertainties in the multiple access computer network field. For one thing, there is no general agreement as to the form that the central processing complexes should take. One of the difficulties involves the rather limited number of simultaneous users that the current state of the art of time-sharing permits a single general purpose computer to serve -- somewhere between one and two hundred in even the largest systems. In order to serve the thousands of customers required by many of the proposed plans for mass utilization of computer utilities, new systems architecture approaches may therefore be required. In this connection some feel that the only way to realize the economies of scale promised by a truly large system is to adopt the super computer approach in which each central complex would contain a gigantic processor connected to an indefinitely expandable pool of memories. Others argue in favour of a multi-computer complex with pools of smaller processors (both general and special purpose) as well as memories and a few even visualize ultra parallel processors whose basic building blocks would be complete mini-computers instead of flip-flops and logical elements.

Speaking more generally, we can have systems with distributed processing and/or data bases, centralized systems, master-slave systems, specialized, multi and general purpose networks, and so on. Each of these different possible structural forms exhibits unique operational, economic and technical characteristics and has important implications for the communications sub-systems, memories, processors, etc., from which the networks are constructed. Interesting possibilities are also presented by central processors in which many functions which are today performed by software, would be built into the machine. With progress in read-only memories and L.S.I., it may soon be possible to build machines which can handle FORTRAN or APL statements, for example, directly without any need for compilers. In fact central processing complexes of the future may well be made up of a large number of specialized machines dedicated to particular applications but capable of working together as required on large problems.

Sovereignty Aspects

Of more immediate urgency than the potential long and medium-term environmental consequences of communications computer applications are their possible impact upon Canadian sovereignty. During the next decade, market forces if unconstrained, may have the following effects:

1. Through foreign ownership of the computer utility industry, Canada may lose control of what most observers predict will eventually become the nation's largest and most vital industry, and the second or third largest by 1980.

2. Increasingly, Canadian computational needs may be served by north-south communications linked to U.S. computer utilities. Such a development would seriously constrain the development of an indigenous Canadian industry, if it were not balanced by a corresponding export of Canadian services to the United States.

3. Many application services of Canadian computer utilities and in particular those concerned with reference and instructional offerings, may be dominated by foreign content to the point where Canadian cultural identity could be submerged.

4. The location, beyond the borders of this country, of data banks containing information about Canadian institutions and individuals might render ineffective any Canadian laws concerning information contained in those systems.

Historically Canada has been unwilling to submit to unconstrained market forces where essential services are concerned. In the development of railroads, telecommunications, broadcasting networks, banking systems, highways and air services, the importance of sustaining an east-west axis has been recognized, and appropriate policy measures have been taken.

PART V

Economic Considerations

Despite the obvious importance of economic factors in the development of a computer utility policy, generally accepted professional analyses of future trends are not yet available. One of the difficulties arises from the primitive state of the current industry. Thus attempting to predict the state of the industry in 1985, for example, is in many respects comparable to predicting the current automobile and highway industries in the days of the Stanley Steamer. Consequently no claim is made that the analyses in this chapter comprise anything more than a starting point for the comprehensive analyses of the Computer/Communications Task Force described in Part IX.

The Current Data-Processing Industry

At the end of 1969, the cumulative investment in computer systems in Canada was approximately $600 million. This is a depreciated value which represents an average investment of $430,000 per computer system and 1,928 *(1) systems where the term "system" includes both hardware and systems software. The revenue from these systems during 1969 was $250 million, up $40 million from 1968, and is expected to reach $300 million in 1971 *(2). Of this revenue, $47 million was accounted for by multi-subscriber time sharing services *(3) and the remainder by normal service bureau operations. Of the time-sharing market, commercial or business operations represented $27 million and scientific applications $20 million.

The distribution and rate of growth of computer installations in Canada is shown in Table No. 1, while Table No. 2 shows the distribution by computer size and industry. At the present time, the largest portion of the data-processing market is accounted for by the Toronto/Ottawa/Montreal areas, with over 50% of this activity in the province of Ontario. Quebec and the Maritime provinces account for 35% and the remaining 15% is distributed throughout Western Canada.

Growth Projections

Historically, both economic and technological forecasts of the data-processing industry have been notoriously unreliable. In the following examples two different but equally reputable approaches yield widely different results:

(a) Historical Extrapolation Approach

In this approach, the historical pattern of investment is computed from available data and then extrapolated into the future. Thus, Table No. 1 shows that the rate of growth of computer installations during 1968 and 1969 apparently levelled off at about 20% per annum although preliminary figures from the 1970 Information Processing Society of Canada census indicate that the rate rose again to 30% during 1970.

If the 20% rate if compounded annually and extrapolated to 1980, it results in a cumulative total of 15 thousand systems or a total investment of $5 billion, assuming an average cost of $430 thousand, less depreciation, per system.*(4)

*(1) Information Processing Society of Canada - 1969 Census of Computers
*(2) E.J. Cody - Univac Canada
*(3) CN/CP Telecommunications Time-Sharing Study
*(4) Trans-Canada Telephone System Telecommission Computer Study

Table No. 1.

COMPUTERS INSTALLED
BY PROVINCE AND MANUFACTURER

	ALTA	BC	MAN	NB	NFLD	NS	ONT	PEI	QUE	SASK	TOTAL	% Growth
IBM	65	81	55	15	10	14	555	1	251	22	1069	
DEC	23	8	9	1	1	5	107		21	8	183	
HON	12	12	6	1		1	78		38		148	
BUR	3	5	2	1	1	8	71		67	4	162	
UNI	12	16	3			2	59		33	5	130	
CDC	8	3	4	1	1	2	33		16	1	69	
CE	2	5		1			28		18		54	
NCR	5	1			1	4	19		16	1	47	
SDS	5	1				1	4		3	1	15	
COL							14				14	
OTHERS	3	4				2	20		7	1	37	
TOTAL 1969	138	136	79	20	14	39	988	1	470	43	1928	20
May 1968	119	107	69	16	9	31	811		410	41	1613	20
May 1967	86	93	57	13	6	25	644		332	23	1279	35
June 1966	69	70	34	12	6	17	443		280	17	948	33
June 1965	52	52	30	8	5	14	330		204	15	710	41
March 1964											502	

Information Processing Society of Canada
Census of Computers
1969

COMPUTERS INSTALLED
BY INDUSTRY AND MONTHLY RENTAL

	UP TO $1,999	$2,000 to $4,999	$5,000 to $9,999	$10,000 to $19,999	$20,000 to $49,999	$50,000 AND OVER	TOTAL
PRIMARY/RESOURCE	26	34	19	9	5		93
CONSTRUCTION	16	14	9	2			41
MANUFACTURING	87	140	71	71	31	6	406
TRANSPORTATION	9	25	16	21	9	7	87
UTILITY	13	17	24	15	17	3	89
COMMUNICATION	19	14	4	5	1		43
DISTRIBUTION	30	66	32	29	3	1	161
FINANCIAL	25	43	41	57	22	4	192
OTHER SERVICES	143	70	39	22	19	12	305
SERVICE BUREAUX	25	49	26	28	13	7	148
GOVERNMENT	84	57	45	33	30	10	259
PETROLEUM	13	10	14	16	9	5	67
OTHERS	13	7	8	5	3	1	37
TOTAL	503	546	348	313	162	56	1928
MAY 1968	369	504	318	249	136	37	1613
MAY 1967	161	467	338	214	92	7	1279
JUNE 1966	83	370	285	134	76		948
JUNE 1965	78	300	116	168	45	3	710
MARCH 1964							502

Information Processing Society of Canada
Census of Computers
1969

(b) Percentage of Gross National Product

Another method of assessing the growth of the computer market is to relate investment to the gross national product. At the present time, the gross cumulative investment of $600 million in computer systems is approximately .8 of 1% of the GNP, and is rising towards the U.S. figure of a little over 1% *(4). The Canadian GNP for 1980 has been estimated to be in the order of $181 billion *(5) and, on this basis, gross investment in computer systems could be in the order of $1.8 billion by that time.

The problem with this approach is the assumption that the computer industry will represent a constant percentage of the GNP over the decade. This is probably unrealistic for an industry which most authorities agree is still in its infancy, and which may well be one of the three largest in the country by 1980. The Historical Extrapolation Approach seems to reflect this possibility, since its $5 billion figure represents an increase to about 3% of the expected 1980 GNP, and may therefore provide a more reliable prediction.

(c) The Transaction-Population Approach

A novel approach to the problem of predicting computer-industry growth has been developed by a consultant *(6) in a market study prepared for the Department of Communications. The study first defines a quantity called a "transaction", and then considers the number of transactions which might be involved in a variety of different Computer Utility application areas. Typical transactions could include making a reservation, asking for a stock quotation, registering a sale, transferring credits from one account to another, etc. Knowing the number of transactions and the rate at which they must be handled for a particular application, it becomes possible to calculate the computer and communication requirements and therefore the required capital investment for that application.

With the aid of this technique, the study concludes that the expected capital investment for all systems likely to be implemented in Canada by 1980 will be between $2.3 billion, if growth depends on normal market forces, and $6.3 billion if the government takes appropriate steps to stimulate the industry.

(d) A Comparative Canada - U.S. Approach

The above projections tend to assume that the Canadian computer needs will evolve in an international vacuum. In fact, we share a continent with the most computerized

*(5) TCTS - CNT/CPT Telecommission Market Analysis - Study 2(e)
*(6) Mr. Lyman Richardson, President, T-Scan, Toronto.

country on earth, the United States. Currently, our neighbours have a two and one-half to one lead over us in the number of installed computers per capita. The U.S. have a total of 63,000 computers for a per capita ratio of 2.5 per 10,000 population while Canada has a total of 2,000 computers for a per capita ratio of 1 per 10,000 population.

If we assume that it is desirable for Canada to stay abreast of the Americans and that public policies will be adopted to ensure this, then the figures we arrive at, based on American projections, are different again. Expert opinion *(7) has predicted that the U.S. could spend $260 billion before 1980 to build and expand data processing and telecommunications systems. Of this total, capital expenditures for telecommunications alone would be at least $100 billion. The remaining $160 billion would be required for computer systems and services.

Obviously, Canada cannot hope to match an investment of this magnitude, but even to equal the same per capita rate of growth, we would still be involved with a bill of 20/200 x 260: $26 billion of $2.6 billion per year, as compared with the current figure of less than $1 billion for both telecommunications and computers.

Of greater significance is the fact that even a $26 billion investment would merely maintain Canada's present position vis-à-vis the United States. To close the gap, an annual expenditure in the order of $5.2 billion or double the U.S. per capita investment would be needed. If we assume that this is split evenly between systems and services, then the 10-year capital investment required would be $26 billion for computer systems and communications combined or $16 billion for the computer systems portion.

This figure of $1.6 billion per year compares favourably with the annual capital addition of the Canadian Electric Power and Gas Industries which, for 1969, was $1.535 billion.

Computer Services Revenue Projections

If we assume that the gross rate of return from computer systems investment must be between 30 and 40%, say 35%, then the revenue that would result for each of the previously described investment cases in 1980 would be:

Historical Extrapolation Approach	$1.75 billion
Gross National Product Approach	$0.63 billion
Transaction Approach	$0.79 billion to $2.2 billion
Stimulated Growth Approach	$5.6 billion

*(7) Business Week, December 6, 1969.

Economies of Integration

One of the major justifications for telecommunications carrier participation in public data-processing that is put forward in Part VI is based upon the supposition that economies of integration result when telecommunications and data-processing are combined within a single organization. If such economies exist and are passed on to the users in the form of lower data-processing and/or communications charges, then it could be in the public interest to permit the carriers to provide public data-processing services.

The question of the sorts of economies that might be realized was discussed in the following extract from a Trans Canada Telephone System document entitled "Response to Communications Canada", dated September 3, 1970:

> "Throughout our original submission and in this one we have indicated that there are types of communication/processing services that could benefit from carrier participation in processing because:
>
> a) it would optimize use of know-how, manpower, space, and other resources.
>
> For example:
>
> - the carriers have an undisputed experience in systems design and 'software' development that would be directly applicable to the design of a total communication/processing system.
>
> - communication and processing technology is rapidly merging. As integrated solid state devices are further introduced in designs, the circuit components of computers and telecommunication switching equipment will become identical. This has two impacts re carrier economies. Firstly, it means that system design know-how in the two fields is going to become increasingly interchangeable and related. Secondly, in some cases even now, the same units needed for communications can, with some additional programming and at incremental cost, provide needed processing services. By about 1980, it is possible that this situation could lead to the development of communications switchers with considerable processing logic and storage capacity. However, this is pure conjecture at this time.
>
> b) it would permit the customer to buy his services from a single provider of total information systems. Hence opportunities for less "red tape" and potentially a system better optimized to the customer's total need.

c) it would reduce the need to isolate system troubles for the purpose of determining which supplier is responsible. This can be complex and expensive on integrated long haul networks where parts of the system are owned and maintained by different parties."

"However, having said this it is equally important to recognize that it is not a universal truth that such economies exist. We feel that in the huge market to be served that there are innumerable opportunities for entrepreneurs and that carrier entry would complement this effort in those areas where our skills and capabilities are most appropriate.

The following additional economies should be realized if the carriers were to provide processing services. However, they might also in large part be realized through cooperation between carriers and entrepreneurs:

d) remote plant maintenance features will become practical and economical. Tests can be conducted from well equipped test centers and looped back via the equipment at the remote computer location. This would reduce the number of visits to customers and speed up maintenance. Such economies would be possible if the equipment at the customers' location had the necessary test features.

e) there will be economic opportunities within the decade to integrate test and other circuit features of telecommunication channels with computers, especially with communications controllers. Candidates for integration are data set functions, automatic dialing, supervisory and control of communication channels, fall back and recovery switching, line hunting for better utilization of communications controller 'ports', and telecommunication terminal equipment."

It is important to note that TCTS in their response were far from dogmatic in their claims for economies of integration. For example they qualify their case with statements like "it is not a universal truth that such economies exist" and "they might also in large part be realized through cooperation between carriers and entrepreneurs."

A very preliminary analysis of the subject is contained in Appendix C of this report. This Appendix contains the results of a special study performed on behalf of the Department of Communications by ProfessorsLen Waverman of the University of Toronto and Donald Cowan of Waterloo University.

In their study, Waverman and Cowan identified several additional possible sources of integration economies. These included:

- Ability of a large carrier to finance investments at a lower cost of capital than an independent data processing firm.

- Economies in research and development because of the increase in scale or in information flows.

- Decreased line and switching costs.

After analyzing these and other possible sources of economy the study concludes that the case for their existence on any meaningful scale in unproven. As illustrated by the comments of Dr. J. de Mercado in Appendix D, however, strong exception to some of the Cowan/Waverman conclusions has been taken by other authorities.

PART VI

Carrier Participation in Public Data-Processing

Introduction

Previous sections of this report have stated that there is a natural alliance between computers and communications and that this alliance expresses itself in the form of computer utilities. This leads to the question of whether telecommunications carriers should or should not be allowed to offer public data-processing services. The carriers being regulated monopolies, some consideration must be given to the advantages and disadvantages of allowing them to enter an unregulated field.

The question is given greater pertinence by the fact that two regulated telecommunications companies, one of them federally regulated, have already begun offering data-processing services to the public.

The recent proposal by the Federal Communications Commission in the United States allowing telecommunications companies to operate unregulated computer utilities gives rise to the possibility that various American carriers may enter the Canadian market.

A further consideration is the fact that the Canadian data-processing industry is already largely controlled by foreign owners. Consequently, measures may be necessary to assure a strong and viable Canadian participation which will be responsive to Canadian needs and which will assure the most equitable distribution of the benefits of the computer to all regional and social groups. In this connection it should be noted that the telecommunications industry in this country is now substantially owned by Canadians.

A corollary of the question of common carrier entry is the need to determine what constraints should be placed upon them if they are allowed to offer data-processing. It is the purpose of this chapter to first summarize the arguments for and against carrier entry and then to discuss a number of different policies under which such entry might be permitted.

Vertical and Horizontal Diversification

In the discussion in this chapter, the terms "vertical" and "horizontal" diversification are used to describe two basically different approaches to carrier diversification. These concepts have come into relatively common use in the United States during the course of the Federal Communications Commission enquiry into the Interdependence of Computers and Communications.*(1)

*(1) Author of the definitions cited above is Prof. Manley Irwin of the University of New Hampshire, an FCC consultant.

Horizontal Diversification

This approach enables the carrier to offer data-processing as a carrier with shared use of facilities, management, personnel and equipment between the data-processing and communications segments of the carriers' business.

Vertical Diversification

In this approach, the carrier establishes a corporate affiliate for the data-processing part of its business that is separate and apart from the parent.

Vertical Diversification Safeguards

In this chapter, whenever vertical diversification is discussed, it is assumed that the following safeguards designed to reduce the danger of unfair competition will apply:

(1) Absolute separation of financial, technical and management resources.

(2) Prohibition of:

a) Cross subsidization and preferential treatment

b) Disclosure to the affiliate of proprietary information obtained by the carrier from competitors of the affiliate

(3) The requirement that the carriers immediately publish and receive approval for a comprehensive, clearly delineated list of data transmission and raw computer offerings and charges.

(4) Detailed monitoring of the implementation of these conditions, and adequate sanctions against infringement.

I. Summary of Arguments and Alternatives

As a result of opinions gathered during the course of the Telecommission, a number of the arguments for and against carrier participation in public data-processing can be summarized as follows:

Arguments Advanced in Favour of Participation

(1) Resources Available to the Carriers

As mentioned in Part IX Section I the full exploitation of the power of the computer utilities in the interests of the

Canadian people will require large expenditures and the mobilizing of all the applicable Canadian resources. The federally regulated telecommunications carriers command technical knowledge, experience and financial resources.

(2) Common Use of Equipment and Optimum System Design

The offering by the carriers of public data-processing and in particular raw computer power, it has been claimed, would facilitate more effective use of total facilities, the development of an optimum system design for national computer utility networks and hopefully reduced costs for both computer and communications services.

(3) National Objectives

As regulated entities, the carriers could be required to bring data-processing services to many small users and to remote and underdeveloped parts of Canada where they might otherwise be unavailable. The offering of public data-processing by the carriers would ensure that, under the coordinating influence of Canadian public policy, the resources enumerated in (1) above would be brought to bear in areas of greatest social and economic value.

(4) Growth of the Application-Service Industry

The existence of computer utility networks based on the offering of raw computer power by the telecommunications carriers as well as others some believe, might lead to a rapid growth of the unregulated application-service industry including the rise of a new class of entrepreneurs who would not need to own and operate their own computer facilities (see Independent Service Retailer, P. 9). In many cases, this industry does not require large capital investment and competition here is clearly in the public interest.

(5) Need for Large Software Organizations

Despite the statements in (4) above, there are certain areas of the application-service industry which do require rather heavy capital investment. The creation of large data bases, the development of large industry wide application packages and the development of the software for major integrated systems: e.g., automated banks, national medical networks, etc., all demand the coordinated work of hundreds of people. At the present time, there are few Canadian organizations large enough to undertake such efforts and the field is dominated by American corporations. The carriers, however, might be able to create several large viable Canadian software and systems

organizations that could compete effectively with their American counterparts.

(6) Restraint on Undesirable Practices

Some U.S. computer manufacturers have established a practice which could spread through the industry of reserving perpetual proprietary rights to any programs run on their machines or to any knowledge imparted to them by their customers. If the carriers, as potentially powerful purchasers of computers, were forbidden to accept these undersirable conditions which the manufacturers seek to impose, a national standard would be established and its general acceptance ensured by the operation of market forces.

(7) Canadian Ownership and Control

An obviously desirable objective in the national interest is that computer utility networks, operating in Canada, should be responsive in terms of ownership and control to Canadian public policy and law. The federally regulated telecommunications carriers (with the exception of British Columbia Telephone, which together with Quebec Telephone is affiliated with a United States corporation) are majority-owned by Canadians.

Arguments Advanced Against Participation

(1) Impact on Existing Data-Processing Companies

Many Canadian independent data-processing companies are undergoing a period of readjustment, and entry by the carriers into the field of public data-processing could intensify the competitive environment in which they operate.

(2) Cross-subsidization and Preferential Treatment

Many respondents to the Telecommission questionnaire (see Appendix A) criticized the propriety of allowing a carrier to offer data-processing services from a monopoly position unavailable to its competitors, alleging that small data-processing companies would be disadvantaged with respect to organizations on which they must depend for essential telecommunications services. If the data-processing services offered by a carrier were unregulated, they could be subsidized from telecommunications revenues. This would be harmful in two ways. First, charges to telecommunications users could be artificially inflated; and second, the carrier could be in a position to engage in unfair competition with its data-processing competitors by price-cutting.

Even if vertical diversification were prescribed, respondents claim there would still be many ways of giving preferential treatment to a quasi-autonomous subsidiary, as for example:

(a) early delivery of new equipment, advance notice of price and service changes and superior maintenance;

(b) special attention to the needs and competitive position of the subsidiary when considering whether to offer new services, the schedule for their introduction and the places or areas where they would be available; or

(c) the disclosure of proprietary information and development plans of competitors obtained through line-leasing arrangements.

(3) Obstacles to Effective Regulation

An amendment to the Railway Act which came into force on August 1, 1970 seeks to prevent cross-subsidization by subjecting all telecommunications services offered by the carriers to regulation, and requiring them to demonstrate the validity of the cost allocations on which tariffs are based. Historically, it has always been found difficult to identify true costs, even for particular elements of telecommunications services; for this reason, a tendency has developed to set total rates of return for the entire operation of the carrier, and to question the costs of specific services only when there is evidence of abuse. The enormous complexity of a horizontally integrated computer utility offering raw computer power, communications, and application services might make it extremely difficult for a regulatory body to arrive at a valid allocation of costs, but this difficulty might be partially overcome by insistence on vertical diversification.

(4) Slow Innovation by Carriers

Some respondents to the Telecommission questionnaire claimed that the carriers are slow to innovate and to introduce new techniques and devices. They further said that the needs of the computer utility industry demand modification of traditional tariffs, practices and customs that were originally established to satisfy the requirements of voice transmission.

(5) Dilution of Telecommunications Resources

The exploitation of recent developments which promise enormous improvement in the quality and diversity of telecommunications services will make heavy demands on the technical and management resources of the carriers. Since these resources are limited, there is a danger that diversification into public data-processing could detract from their ability to meet their primary telecommunications obligations.

II Basic Policies

The many possible policies that might be adopted seem to break down into seven basically different approaches.

A. The carriers would be barred from providing either raw computer power or application services to the public.

The basic arguments for and against this policy have been summarized in the preceding section.

B. The carriers would be permitted to provide both raw computer power and application services via horizontal diversification but without regulation.

Under this policy, the carriers would be providing data-processing services under conditions of unregulated competition and communications services as a regulated monopoly. Because of the horizontal structure, however, there would be nothing to prevent sharing of equipment, plant and personnel between the two services.

It is claimed that this policy would offer possibilities for providing the technical and economic advantages of an integrated total systems approach and, at the same time, maintain the existing highly competitive data-processing market. On the other hand, in an unregulated environment the carrier would be free to subsidize the unregulated data-processing segment of his business from the "guaranteed" revenues of the regulated segment and the arguments concerning cross-subsidization and preferential treatment would apply.

C. Carriers would be permitted to provide both raw computer power and application services via horizontal diversification but as a regulated activity.

Conceivably, this policy could avoid the risks of cross-subsidization of Policy B. For, with a regulatory commission approving the tariffs for both communications and data-processing, it would be easier than in Policy B for this commission to verify the correctness of the cost allocation procedures employed in the proposed tariffs. Further, since the service would be regulated, the socially desirable feature of equal access anywhere in Canada could also be more easily ensured. On the other hand, as mentioned in Section 1, there are serious regulatory problems in establishing true costs even for communications. As a result, there has been a tendency to set total rates of return for an entire carrier and to question specific service costs only when there is evidence of abuse. Consequently, in view of the enormous complexity of computer power, as demonstrated in Part I, a regulatory body would be faced with a task of very great proportions in attempting logically to analyze a carrier's figures for a combined computer/

communications service which also included applications services.

D. Carriers would be permitted to provide both raw computer power and application services via vertical diversification without regulation.

This policy which is the one proposed by the F.C.C. in the United States attempts to overcome the problems of cross-subsidization by forcing the carrier to establish a separate subsidiary for the data-processing portions of its business. Sharing of personnel, common equipment and plant would be forbidden by law and the subsidiary would enjoy an autonomous corporate existence. A further variation of this policy would also forbid the sale of services by the subsidiary to any telecommunications carrier.

The most compelling arguments in favour of this policy are that it brushes aside the problems of regulation and the cost allocation difficulty, and could lead to the establishment of several large important software organizations. The main arguments against the policy have already been enumerated in section 1 of this chapter and involve the dilution of carrier resources and the danger of unfair competition. In addition, if the separations were total, this might have a bearing on the social justification for the carriers entering the data-processing business. For, from the point of view of the public, important reasons for permitting such entry involve the claimed economic dividends of the total, i.e., combined communications/computer, systems approach and the possibility of promoting desirable social goals through regulation.

E. Carriers would be permitted to provide raw computer power via horizontal diversification on a regulated basis but would be completely barred from the application service field.

This policy would make the telecommunications carriers "Telecommunications/Computer Utility Carriers" as defined in Part I. It has been suggested that this might permit the public to reap the benefits of both optimized overall computer/communications systems design and regulation in an area where it is feasible. The appropriate use of regulatory authority might assist in ensuring the widespread availability of computer power everywhere in Canada. Eliminating the need for heavy capital investment on the part of application service organizations might help the growth of the application services industry, as described in section 1 of this chapter.

Regulation of raw computer power offerings would seem to present fewer difficulties than in the complex applications services field. On the other hand, the difficulties of

equitable allocation of costs between the computer and communications functions and of defining "raw computer power" would remain.

Objections to this policy that have been offered are:

1) It would render a potentially large source of Canadian capital unavailable to the applications service industry and thus could hinder the growth of those portions of that industry where size and consequently large capital investments are important.

2) If real advantages of integration were realized,* the policy could in the long run eliminate competitive sources of raw computer power and create a carrier monopoly of the industry.

3) Both carriers and independent data-processing organizations have questioned the economic viability of an organization which offers only raw computer power.

F. Carriers would be permitted to provide raw computer power, via horizontal diversification and application services via vertical diversification with the affiliate banned from selling services to any carrier and from selling raw computer power.

This policy would permit the carriers to enter the application service business, subject to rigorous controls on a non-tariffed basis via an arms-length corporate affiliate and to also offer raw computer power on a tariffed basis through horizontal integration as in Policy E. In order to eliminate the possibility of indirect cross-subsidization through a captive market, the affiliate would be forbidden to sell to both its parent and any other carrier. In addition, it would also be prevented from offering raw computer power, either directly or as part of a service package which could wrap its own hardware and software costs into a single bundle.** If it were not for this latter prohibition, there might be a natural tendency for the carrier to offer raw computer power through its unregulated affiliate rather than directly on a regulated basis. This, it has been mentioned, could defeat one of the primary reasons for permitting carrier entry into the public data-processing field. In theory, this problem could be avoided by also tariffing the offerings of the vertical subsidiary, but this would create fundamental regulatory difficulties. Consequently, the policy requires the affiliate to obtain that power which it needs for its service packages from either the regulated carriers or a truly independent computer utility. For the

* But Appendix C indicates they may not exist.

** This, of course, would not prohibit the affiliate from offering an integrated hardware/software service package in which the raw computer power component was obtained from another organization.

purposes of the policy, a computer utility would not be regarded as independent if it were associated in any way with the carrier affiliate or any organization having an interest in that affiliate.

With respect to the raw computer power area, the advantages, disadvantages and impact of this policy would be identical to that of Policy E. An advantage over Policy E is based upon the claim that the carriers would be able to create several large viable Canadian software organizations that could compete effectively with their American counterparts.

G. The carriers would be prohibited from directly supplying either raw computer power or application services to the public but would be permitted to act as a merchandizer for such services on behalf of independent data-processing organizations.

This policy was suggested by Northern Electric and included in the TCTS Brief "Response to Communications Canada" presented to the Department of Communications on September 3, 1970. It could take many forms but typical features might include:

1) The carriers would sign blanket agreements with a number of independent data-processing companies in which they would agree to advertise the DP organizations' offerings, provide customer assistance, directories etc. and perform system accounting and billing.

2) All carrier customers would have access to all data-processing services for a nominal monthly rate over and above the regular telephone bill (about $10.00) plus a toll charge of so much per program.

3) Typical services mentioned in the TCTS brief which might be available include:

a) over touch tone telephone:

* ski reports
* highway condition reports
* stockmarket quotations
* weather reports
* news briefs
* details of retail store sales
* help wanted
* elementary computation
* programmed instruction

b) over more sophisticated alpha-numeric terminals:

* all the services available in a)
* normal time sharing computer services
* ability to be an author (or supplier) for both levels of service.

From the user's point of view, the most attractive feature of this policy is the freedom that it gives him to utilize a large number of different data-processing services and organizations. Instead of having to sign a separate contract with each organization whose services he wants to use and paying a separate monthly connect charge ($100 or more) to each, he is guaranteed access to all services via the blanket carrier contract.

For the data-processing organization the principal advantages include:

* access to a much wider market than might otherwise be the case
* a strong incentive for the carriers to introduce distance independent tariffs with a consequent expansion of each data-processing organization's operating territory to include the entire nation
* reduced marketing, billing and collection costs.

On the negative side, it has been claimed that this policy would reduce competition among processing suppliers, reduce the benefits of innovation from the supplier source and place excessive authority in the hands of the communications carriers.

PART VII

Other Policy Considerations

In addition to the question of telecommunications carrier participation in public data-processing there are a number of other policy considerations of equal or greater importance. These have been touched upon in earlier sections and include:

Wide Band Services
Separate Digital Communications Network
Foreign Attachments
Multiplexing

Wide Band Services

In Part IV the subject of wide band services such as those provided by Picturephone or potentially by cable TV was introduced. These services are important to the future of computer utilities as many of the more imaginative (and socially important) services discussed in Part II require the transmission of pictorial material. Consequently these new services and the institutional arrangements for providing them form a vital part of any overall computer utility policy. Such services today involve many different jurisdictional authorities and operating organizations. CATV, for example, is obviously a wide band service which is currently regulated in technical areas by the Department of Communications and in all other matters by the Canadian Radio-Television Commission. Communications carriers, including those that are federally regulated, are involved in the industry through the provision of hardware and the mechanism of pole attachment agreements. Services, however, are mainly provided by a host of independent entrepreneurs covering a wide range of financial commitments. Any change in the existing CATV policies involves many constitutional, economic and technological considerations. These are currently the subject of Government study and analysis and their proper treatment would be beyond the scope of this report.

Picturephone Service

A possible alternative to the cable systems is provided by the carrier's Picturephone service. This has the significant advantage of being able to use the existing twisted pair distribution systems used for normal voice communication. It also provides full two way video communications, a host of sophisticated user features and capabilities for high speed data transmission. It is currently limited by its high cost, about $160 per month, and the inferior picture definition that results from the restricted signal band width, about 1.5 MHZ compared with the 4.5 MHZ of conventional commercial television. Both of these limitations however, could be alleviated as the service develops.

Separate Digital Communications Network

Although the development of video band width services and the role of the carriers and CATV companies in their provision are important considerations for future information utilities, there are a number of basic communication questions that are of much greater immediate importance. One of these concerns the optimum means for providing data transmission services and in particular the question of whether such services should be integrated with conventional telephone services or supplied by a separate dedicated digital network.

Some of the differences between the characteristics of the present switched voice network and the needs of data processing organizations were mentioned in Part IV. Others are detailed in the responses to the Telecommission Computer/Communcations Inquiry summarized in Appendix A. Another excellent summary of the arguments is contained in a review of the DATRAN arguments before the Federal Communications Commission presented in a recent OECD publication.*

"Specifically, Datran argues that the costs of existing communications services have not declined in proportion to data processing costs; that existing analog transmission systems require costly modulator-demodulator equipment to convert digital signals to analog and back again; that current switched services often take significant time to establish connections, (which detracts from the productivity of the data terminal and operator); that transmission systems originally engineered for voice and record transmission do not meet the more demanding reliability standards of digital data transmission; that existing switched services generally cannot handle full-duplex transmission (which leads to reduced throughput and wasteful line reversal time); that the basic switched services, originally intended only for voice and record, provide only two major speed selections whereas many new data applications require faster and more varied choices; that attempts to establish a switched connection for data transmission can be impeded by the high incidence of busy signals currently being experienced in points and times of heavy user concentration; that communication between terminal devices utilizing different line speeds is not possible in most existing major networks;

* A Preliminary Survey of Data Communications in the United States edited by John M. Richardson and Robert Gary - Office of Telecommunications, United States Department of Commerce, OECD. Document no. DAS/SPR/70.66. (Organisation for Economic Co-operation and Development).

that many data transmissions can be completed in far less than the minimum charge periods now in force; and that while common carriers have recently begun to drop barriers against sharing and interconnection, much confusion and difficulty continues to exist in user attempts to apply this flexibility.

Datran attributes many of the asserted unmet needs of data transmission users to the circumstances that the existing switched facilities of common carriers were originally engineered only for voice and record analog transmission services, a constraint which does not exist in its proposed digital system. The three basic integrated components of Datran's proposed end-to-end system (trunking system, switching system, and local distribution system) are engineered specifically for, and dedicated to, digital data transmission. Thus, a subscriber need not convert his digital signals to a different (analog) transmission mode, since the system transmits the subscriber's signal in its original form. Moreover, as the signal is transmitted through the system, it is continuously regenerated into a new, clean and conditioned signal without the amplified system noise present in analog systems."

These Datran arguments are echoed in a special Telecommission Study performed by consultant Lyman T. Richardson. In this study Mr. Richardson argues strongly in favour of what he calls a "transaction oriented network" in which data would be transmitted by special store and forward equipment in the form of packets of characters called "transactions". Typically each packet might contain somewhere between one and two hundred characters. The tariffs for such a network would involve a fixed charge per packet and would be independent of distance.

Involved in the Richardson proposal is another basic question concerning digital services. This is the question of whether the network should be "circuit switched". Circuit switching is of course, the basis of the existing voice networks and involves the setting up of an exclusive wire path or circuit between the calling parties. This circuit is maintained until a call is terminated regardless of whether information is actually being sent over the wires.

It has the advantage of great simplicity since no storage or manipulation of data is involved and information is received with exactly the same order and timing in which it is transmitted.

For transmission of continuous streams of data, voice or video information, or lengthy messages where the duration of the message is an order of magnitude or so greater than the circuit set up time, circuit switching is quite satisfactory. Thus a circuit switched service like Bell Canada's MULTICOM may be reasonable for applications like the transfer of large files or the dumping into distant computers of the contents of a magnetic tape, but it is not nearly as satisfactory for short intermittent messages of the type encountered in interactive time sharing systems, stock quotation services, reservation systems, point of sale recording and so on.

Such applications are distinguished by relatively long holding times, hours in the case of some time sharing situations, but extremely low line utilization rates. Information tends to be transmitted in short bursts with long intervals between bursts so that most of the time the circuit remains idle. Despite this, it is not available to any other customer and the user is forced to pay for the total elapsed time from the original completion of the circuit to its termination. This has a number of undesirable consequences:

1. Carrier circuits and equipment are employed very inefficiently.

2. The high cost of long distance service, in terms of actual quantity of information transmitted that results from the circuit switching optimized time and distance based tariffs, inhibits the development of interactive national computer networks and unduly inflates user charges.

3. In local areas, carrier facilities may become overloaded by data traffic so that unsatisfactory service is received by all customers both voice and data. New York City, of course, provides the classic example of such a situation.

4. In order to obtain more efficient use of the circuits, users must often resort to the use of expensive multiplexing and data compaction equipment or utilize remote batch processing when time sharing might be more satisfactory.

It is claimed by many authorities that the creation of a special "message switched" network is the best way around these difficulties. In such a network no permanent circuit is established between the calling parties. Instead the message to be transmitted is assembled at the user's terminal or in a local concentrator, in the form of a "packet" or transaction which also contains destination information. The message is then propagated from node to node through the network with routing and timing that depends upon the instantaneous traffic and circuit conditions in the network. By delaying and rerouting messages at each node, the system is able to ensure that available circuits are efficiently shared among many different messages. This leads to very high circuit utilization factors and makes possible the desirable transaction oriented tariffs - tariffs that could be much less costly for many classes of users than the conventional time and distance rates.

On the other hand message switching does present a number of problems:

1. Processing and storage is required for every packet at every node in the network and this can be costly.

2. Timing between successive packets is destroyed.

3. Successive packets may take different routes to their destination and thus arrive out of sequence.

Outside of Canada, the decision to create independent digital networks, separate from the conventional voice networks, although in some cases sharing certain trunks and local loops, appears in many countries to have already been made. In the United Kingdom for example, the British Post Office is constructing a network which will probably consist of two sub nets, one circuit switched which will be built on top of the present voice network and the other packet switched, which will be completely separate. The packet switched system is expected to be based upon the pioneering work of a group at the National Physical Laboratory, Teddington who, under the direction of Mr. D.W. Davies, have had an experimental network in operation for over a year now. West Germany, via a consortium consisting of the Post Office, Siemens, AEG Telefunken and the Nixdorf Computer Company has a circuit switched system under construction that is completely separate from the voice network. It is expected to be completed in 1977. Sweden is also building a dedicated digital network, but in this case it will be physically integrated with the voice network. In the case of Japan, also, planning is now well under way for a dedicated data communications network.

In the United States developments are moving very rapidly and include:

1. Initiation in January, 1970 of a two year cooperative experimental program involving the Post Office and the Western Union Telegraph Company. This will permit Western Union's INFO-COM and Telex subscribers

in twelve cities to send mailgrams via computer to teleprinters in 110 participating post offices for delivery the following morning.

2. Introduction by AT&T of the "DATREX" data communications service which provides time sharing computer systems with a concentration facility to interconnect many remote computer imput-output terminals into a smaller number of computer ports.

3. Rapid growth of AT&T metropolition PCM facilities utilizing the T1 carrier system. The 1.544 megabit/sec data stream now serves virtually all metropolition areas and involves some 10 million channel miles. When development of the Bell System's 306 data set is completed, it will be possible to directly apply a data rate of 1.344 megabits/sec to the carrier stream.

4. Development and partial completion of sophisticated government digital networks like AUTODIN, the GSA Advanced Record System, the NASA Deep Space Tracking Network and the National Crime Information Network.

5. Introduction of commercial Picturephone service incorporating a digital inter city network and also providing high speed computer to computer communication at 460.8 Kilobits/sec.

6. Announcement by AT&T on April 14, 1970 that they were focussing on a digital network which would provide a wide mix of speeds from 150 bits/sec to 1 megabits/sec; fast set up times, of the order of 3 seconds; short charging intervals; abbreviated dialing and "data block", i.e. transaction or packet switched techniques and corresponding tariffs.

7. Proposals by a number of organizations to establish new independent data carriers. These proposals are currently under study by the FCC and the chances are good that one or more new regulated specialized carriers will be created to compete with AT&T.

8. Successful demonstration of the ARPA Network. This experimental store and forward network is designed for the transmission of messages from 1 to 1000 characters in length and involves some 20 nationally distributed nodes. It is intended to provide for the economical sharing of the computer and software resources at any node with all other nodes. Thus it incorporates many of the features that have been postulated for the Trans Canada Computer Network in Part VIII.

Returning to the Canadian problem, there are many different institutional arrangements that might be utilized to augment and improve our data communications services. They include:

1. Leasing the responsibility for the planning and creation of data communication services, as is the situation today, with the existing telecommunications carriers.

2. Licensing of new competing private specialized data communication networks as in the US Datran proposals.

3. Creation of a new Federal Crown Corporation which would construct and operate a dedicated national data communications network. This network might lease certain local loops and long distance transmission facilities where necessary from the TCTS system, but would otherwise be granted a full monopoly of all public data communications services.

4. Creation of a Federal Government sponsored body like the Canadian Computer/Communications Agency described in Part IX to develop in cooperation with all interested parties a broad national plan for data communication services whose implementation however, would be the responsibility of the existing telecommunications carriers assisted where necessary by Federal and perhaps Provincial subsidies.

5. Creation under Federal Government Charter of a new National Data Network Corporation owned jointly by the Federal Government, the carriers, (both Federal and Provincial), the Telesat Corporation and the general public. Operating under the overall planning authority of a Federal body such as the proposed Canadian Computer/Communications Agency, this new corporation would have the responsibility for constructing and operating a dedicated national data communications network on a monopoly basis. As in option 3 however, it would lease certain facilities from the TCTS, the Telesat Corporation and CN/CP systems.

A full discussion of the pros and cons of these different policy options is beyond the scope of this report, however, the Canadian Computer/Communications Task Force described in Park IX will be undertaking a comprehensive cost/benefit analysis of these and many other options with the objective of providing definite recommendations to the Federal Government.

Foreign Attachments

The development of remotely accessed data-processing systems has led to widespread discussion and even litigation concerning the issues and problems arising from the interconnection of privately owned terminal devices (foreign attachments) with the carrier facilities.

Until recently, it was the policy of most telecommunication carriers to forbid the attachment of any foreign, i.e. non carrier supplied, equipment to the public switched networks. This prohibition was justified on the grounds that the carriers were responsible for the overall quality of the service and that they would not be able to guarantee the

integrity of the total system and protect other customers if equipment over which they had no control was connected to the network. On the other hand, both users and independent manufacturers of terminal equipment pointed out that such a policy seriously restricted the choice of equipment available to the user, artificially inflated his costs, impeded the development of a viable independent terminal manufacturing industry and exercised an inhibiting influence over technological progress.

The first major breach in this policy occurred in the United States with the issuance by the FCC in June 1968 of the "Carterphone Decision". This decision ordered the American Telephone and Telegraph Company to delete general prohibitions against interconnection and customer attachments from its interstate message toll tariffs. As a result, new tariffs were submitted which permitted foreign attachments provided that they were connected through a carrier provided and tariffed network protective and/or network control signalling arrangement.

In Canada the carriers in general have followed the American example and relaxed the interconnection restrictions. Thus at the present time customer owned computer terminal equipment, for example, may be connected to the networks provided connection is achieved either via a customer or carrier supplied acoustic coupler or via a carrier supplied protective coupling device. In either case however, all network signalling functions must be performed by carrier supplied equipment. Typical of the protective devices employed by the carriers is the Bell Data Connector Equipment. This is a wall mounted device measuring approx. 4¾" x 7¾" x 1¾" and weighing about 1¼ lbs. For each unit that he requires the customer is charged a monthly rate of $4.00 and a service charge of $15.00. It provides suitable terminals so that customer provided modems can be connected to the switched telephone network. Bell Canada, however, retains responsibility for network control including switch hook, dialing and other control functions.

According to Bell Canada, the Data Connector has the following functions:

"(a) To provide an access for customer provided modems to the switched message network."
"(b) To provide necessary features for network control."
"(c) To allow attendants to manually transfer control of the telephone line between the telephone set and customer provided data modem."
"(d) To limit signals above a specified value, if the customer's power level is too high in order to prevent overloading of telephone facilities."
"(e) To protect personnel from injury and equipment from damage due to hazardous voltages. The maximum metallic surge due to lightning the modem may encounter is 25 volts."

The overall subject of "foreign attachments" in the Canadian context has been treated in Telecommission Study 8(b)iii "Problems Relating to the Interconnection of Terminal Devices With Common Carrier Provided Telecommunications." This study indicated that both users and equipment manufacturers are still unsatisfied with the current carrier practices. In this connection, in a brief to the Telecommission entitled "The Users Viewpoint" the Canadian Industrial Communications Assembly, recommend:

"(a) The establishment of standard technical interface characteristics to permit terminal devices to interconnect directly with the lines of the common carriers."

"(b) The establishment of a central agency, similar to the Canadian Standards Association, to test and certify the various equipment offerings of independent manufacturers. These tests would ensure this equipment meets the technical standards set by the common carrier for the interconnection of the devices directly to their network."

Support for these recommendations was contained in a report*(1) to the FCC by a special panel of the National Academy of Sciences of the United States, which while concluding that uncontrolled interconnection would be harmful also stated:

"--- the following two approaches - used either alone or in parallel in such proportions as non-technical factors might determine - can supply the required degrees of protection for the network, including network control signalling:

1. Protective arrangements as required by the tariffs.
2. A properly authorized program of standardization and properly enforced certification of equipment, installation, and maintenance."

Even stronger support was contained in the recommendations of a subsequent FCC sponsored study*(2) performed by Dittberner Associates which stated:

"In essence, we recommend that customer-provided equipment be allowed to interconnect directly to common carrier networks without the necessity of common carrier provided interconnecting arrangements as long as such equipment meets common carrier developed and FCC approved standards for network protective capability and is installed and maintained by an FCC certified installation/maintenance organization or individual contractor."

*(1) "A Technical Analysis of the Common Carrier/User Interconnections Area" - June 1970
*(2) 'Federal Communications Commission, Interconnection Action Recommendations," September 1970; Dittberner Associates, Bethesda Maryland.

Similar suggestions are contained in the discussion of possible roles for the Canadian Computer/Communications Agency in Part IX of this report. In fact the suggested standards role proposed for the Agency is close to that prepared by Dittberner Associates for the "Joint Council of Telecommunications." This it is suggested should consist of manufacturers, telecommunications users and common carriers and should develop standards and recommend them to the FCC for possible inclusion in the tariff.

The certification role in the Canadian Agency scheme would however, go further than the Dittberner proposal in that it would also include the certification of carrier supplied equipment.

Multiplexing

Telecommission Study 8(b)iii as well as many respondents to the Computer Utility Inquiry point out the developing importance of "multiplexors". Study 8(b)iii for example states:

"One developing variety of terminal device that should not be overlooked is the multiplexor. Their main function is to derive channels from a selected bandwidth as required. For instance, a multiplexor may derive twelve 300 baud channels from one voice circuit after the network connection is established. Though these terminals are more appropriate to private-line use, some system designs have applied them to private lines between large centres but which are connected to the local switching in one or both locations. Interconnection practices at present, limit the manner in which multiplexors may be used, and appear to deprive the user of benefits he could obtain from more efficient use of his communication channels.

The use of multiplexors has both economic and technical advantages to the user. From the technical point of view, flexibility in the use of bandwidth at the users' discretion is particularly attractive. Among the economic advantages is one that results directly from the telephone carriers' rating structure for voice channels; for example, the user may obtain twelve low-speed channels more cheaply by derived them from a voice-private-line than he can by leasing twelve separate low-speed channels directly from the carrier.

The employment of user-owned or leased multiplexors would appear to the users to have significant long-range advantages which will not be fully realized without appropriate changes in interconnection practices and rating structures."

At the present time, carrier approved multiplexors may be owned and attached to the carrier lines when the circuits terminate in a foreign country or they may be used on intra Canada circuits by several users where the multiplexed signals terminate in a computer and the carrier bills one user, usually the Computer Utility organization, for the long haul service. Users however would like to go beyond this limited application and have the right to utilize multiplexors for unrestricted sharing of communications long haul facilities. Under this policy a

group of users could band together, rent a long haul wide band line between say Toronto and Vancouver, install multiplexors in both cities and thus provide low cost communications service for themselves between the two cities merely by dialing the local multiplexor. Alternatively, a special multiplexing company could be established to provide the same service to the general public.

At the moment, both of these alternatives are prohibited by the carriers on the grounds that subleasing is tantamount to reselling circuits and thus establishing pseudo telecommunications carriers. Nevertheless, unless the carriers themselves are willing to readjust their rate structures to provide the same savings as "private multiplexing", there would seem to be little rational justification for the continuation of such a prohibition.

PART VIII

Overall Policy Options and Consequences

There are, of course, dozens, if not hundreds, of possible policies which Canada could adopt for dealing with the challenge of the computer utility. Fortunately, however, these policies tend to cluster naturally into eight basic policy groups and in this section the pros and cons of each of these groups are discussed. The groups are:

1. Unrestricted Competition
2. Constrained Competition
3. Privately Owned Total Computer Utility
4. Government Owned Total Computer Utility
5. Multiple Carrier Owned Total Computer Utilities
6. Single Telecommunications/Computer Utility Carrier
7. Integrated Network of Telecommunications/Computer Utility Carriers.
8. Integrated Network of Computer Utilities - The Trans Canada Computer Network.

(1.) Unrestricted Competition

Under this policy the Computer Utility industry in all its aspects would operate in a normal competitive environment subject only to the same general business laws that apply to other enterprises in a basically "free" enterprise oriented society. All of the previously discussed business forms would be permitted and both the telecommunications carriers and government organizations would be free to engage in any aspect of the business. Likewise, computer organizations and others, would be permitted to perform, if they so desired, certain communications functions that are normally restricted to regulated telecommunications carriers. These would specifically include message switching, operation of shared communications links, and use of own terminal and modem equipment.

Claimed Advantages of Policy Group 1

1. Direct government financial involvement would be minimal although governments would not be precluded from operating competitive services if this was judged to be in the national interest.

2. Ensures widest possible area of financial support - a very important consideration in view of the large capital requirements and current shortage of capital in this country.

3. Provides maximum encouragement of risk taking and innovation and, thus, ensures rapid application of new technology and widest range of new services.

4. Involves minimal interference with established business framework

5. Would require only minor legislative action and no constitutional changes

6. Insures that know how and experience available in all areas of the computer/communications and service bureau industries will be utilized.

Claimed Disadvantages of Policy Group 1

1. If significant economies of scale and integration exist, there is a serious danger of eventual monopoly.

2. Uneven financing and, in many cases, inadequate financing might make it difficult to ensure adequate protective mechanisms in such areas as file integrity and privacy.

3. Market place, rather than social or national needs, would determine type, quality and distribution of services.

4. United States interests would probably own and control the Canadian industry.

5. Many computer centres and data bases would be located in U.S.A. and merely connected to switching centres or distribution points in Canada.

6. It would be difficult to prevent regulated telecommunications carriers from recouping possible losses in competitive segment from regulated portion of their business and thus eliminating competition.

7. There would be wasteful duplication of communications facilities, uneconomic and inefficient use of scarce resources and poor system planning, with resultant higher costs or poorer service for consumers.

8. There is a danger of "cream skimming" of communications business by non-carrier organizations - again with resultant higher costs for many Canadian consumers.

9. There is danger of carrier discrimination against competitors.

10. It would be difficult to establish and enforce standards

11. Interconnection among the many competing systems would be difficult to implement.

12. Fragmented industry could result in wasteful duplication of facilities.

(2.) Constrained Competition

Obviously, there are innumerable ways in which the unrestricted competition of the preceding policy could be constrained, but only two will be considered here:

Option (a) - Unrestricted competition as per policy 1 would exist except that telecommunications carriers would be forbidden to enter the data-processing business and computer organizations would be forbidden to perform communications functions. This, in essence, with a few minor exceptions, is the policy that currently exists in Canada.

Option (b) - Unrestricted competition as per policy 1 would exist except that telecommunications carriers would be forbidden to enter the data-processing business. Computer organizations, however, would be permitted to provide certain communications services.

Claimed Advantages of Policy Group 2 - Option (a)

This policy incorporates all of the claimed advantages of policy group 1 although in a somewhat diluted form because of the continued separation of the computer and communications areas of business. In addition, however, the following extra advantages are claimed:

1. The possibilities of carrier discrimination and subsidization of unregulated business from the regulated portions are eliminated.

2. It would prevent wasteful duplication of communications plant and "cream skimming" of communications business by non-carrier organizations.

3. It would reduce dangers of monopoly by separating communications and data-processing aspects.

4. It would facilitate interconnection and standardization of terminals since telecommunications carriers would control communications.

Claimed Disadvantages of Policy Group 2 - Option (a)

Most of the disadvantages of policy group 1, except as noted in the preceding section persist in this policy group. In addition the following are also claimed:

1. Policy fails to recognize the technological fact that communications switching can, in many cases, be more economically performed by local computers than by carrier switches.

2. In a capital short situation, one of the largest potential sources of Canadian capital is denied access to the computer utility business.

3. Conditions of "natural monopoly" are not obviously present in many aspects of data communications but this policy denies the public the advantages that competition could provide.

4. Optimum system design requires integration of the processing and communications elements but this is precluded by the separation of ownership and control.

Claimed Advantages of Policy Group 2 - Option (b)

There are three significant advantages claimed for this policy over option (a). They are:

1. It recognizes the fact that communications switching can often be more economically performed by local computers than by the telecommunications carriers.

2. It breaks the monopoly positions of the carriers in data communications and thus provides the public with any advantages that may flow from increased competition.

3. Optimum system design, through integration of communications and processing becomes possible.

Claimed Disadvantages of Policy Group 2 - Option (b)

Except as noted under advantages, this policy incorporates all of the disadvantages of option (a) in addition to the following:

1. It is unfair to the carriers in that it denies them access to the data-processing field but permits data-processing companies to compete with them in the communications field.

2. It opens up all of the "cream skimming" possibilities mentioned in policy group 1.

3. It would be difficult to enforce standards and provide for interconnection among the many competing communications systems.

4. It could result in higher communications rates and/or poorer service for consumers in many parts of Canada.

(3.) Privately Owned Total Computer Utility

This policy would establish a single regulated, privately owned entity as a Total Computer Utility, as defined in Part I. It would then become the sole provider of computer power (communications, processing and services) for the nation.

Claimed Advantages of Policy Group 3

1. It would make available very large amounts of capital for research and development, planning and provision of reliable, well engineered facilities.

2. It would permit an optimum overall system design with properly integrated communications, processing and software packages.

3. It would eliminate interconnection and standardization problems.

4. It would prevent wasteful duplication of services and plant.

5. Regulatory problems would be simplified since only a single entity need be controlled.

6. Government financial involvement would be minimal.

Claimed Disadvantages of Policy Group 3

1. The computer utility, impacting as it will upon every facet of our society promises to become not only the prime mover of the future Canadian society but also the foundation upon which that society will be built. This policy, however, would concentrate responsibility for this vital element in one private organization potentially representing the greatest concentration of social and economic power yet seen in this country. Although one can envisage regulatory agencies which could, in theory, represent the public interest, past experience with the effectiveness of such agencies is not reassuring. In fact, it is likely that the computer utility corporation would soon become so powerful as to be, for all practical purposes, completely beyond the control of the people. The potentialities for abuse in such a situation are obvious and it is difficult to see how a meaningful Canadian democracy could continue to exist under such conditions.

2. All of the classic arguments against monopoly would apply, e.g. slow response to technological change, lack of incentive for innovation, protection of inefficient procedures and practices, isolation from consumer needs and pressures, poor service and corrupting influence upon public officials.

3. Although there certainly are economies of scale in the communications and probably in the computer area of the computer utility field, there is no evidence of such economies in the service area. In fact, the contrary may well be true, so that a few highly skilled programmers can be vastly more productive than a large organization with its inherent communication bottlenecks and high overhead. Consequently, there is no current or foreseeable justification for the total computer utility concept, as defined in Part I.

4. The enormous capital investment required for establishing a single "Total Computer Utility" capable of providing the sort of services postulated in Part II would probably require foreign financing and a consequent serious threat to Canadian sovereignty.

(4.) Government Owned Total Computer Utility

As in Policy 3, this policy would establish a single Total Computer Utility but, in this case, the utility would be owned by the Federal Government rather than a private corporation.

The claimed advantages and disadvantages of this approach are essentially those of Policy 3 with two significant differences:

(a) Although the computer utility would still represent an enormous concentration of power, the fact that it was government owned would ensure that ultimate control would rest with the people of Canada. Consequently, the menace to democratic institutions inherent in the private monopoly approach would be alleviated if not totally eliminated.

(b) Very heavy government investment would be needed with something in the order of $8 billion required for purchase of the existing telephone system alone.

(5.) Multiple Carrier Owned Total Computer Utilities

Under this policy, each of the Canadian telecommunications carriers would become a regulated Total Computer Utility franchised as the sole source of computer/communications power within its operating area. By providing for multiple ownership of the Canadian Computer Utility business, this approach would greatly reduce the social dangers inherent in Policy 3, without requiring the heavy government investment of Policy 4. Further, by resting responsibility with the existing carriers it would ensure:

(a) development of integrated systems with a proper melding of the different computer and communications elements.

(b) full utilization of the technical and managerial talents of the carriers.

(c) availability of significant capital resources for the development of the system.

On the other hand, all of the previous arguments against the Total Computer Utility concept would still apply.

(6.) Telecommunications/Computer Utility Carrier

A single regulated entity, which could be either privately or government owned, would be established as a Telecommunications/ Computer Utility Carrier, as described in Part I. It would be prohibited from providing services; i.e. application, software, and instead would supply the communications and computer facilities which others would then use for their own purposes or, in the case of service retailers, for providing services to the general public.

Claimed Advantages of Policy 6

1. The policy divides the industry into a regulated monopoly segment and an unregulated competitive segment with the regulated portion restricted to those areas where elements of natural monopoly appear to be present.

2. The overall system design could be optimized through the efficient integration of the different processing and communications elements.

3. It would prevent wasteful duplication of communications and computer plant and "cream skimming" of business by unregulated organizations.

4. It would facilitate interconnection and standardization.

5. Regulatory problems would be simplified since only a single entity need be controlled.

6. It could insure that adequate financial resources would be available for expansion of the physical plant and incorporation of suitable protective measures.

7. It would simplify long-range planning.

Claimed Disadvantages of Policy 6

1. It would exclude the members of the TCTS from the data field and thus from the fastest growing and potentially largest area of the telecommunications business.

2. Many of the most exciting future applications of the Computer Utility depend upon a combination of conventional TV/voice communications and data, e.g., computerized shopping. To provide such services under this policy would require costly, nation-wide duplication of the telecommunications carriers' facilities by the computer utility carrier.

3. Many existing computer utilities have invested heavily in computer hardware, but this policy would prevent such organizations from making their computer power available to the public.

4. There are serious technical and economic arguments against the general viability of the pure purveyor of raw computer power concept at this stage of development of computer utilities.

5. Historically, regulated monopolies have all too often been plagued with slow response times in meeting new demands for service and incorporating technical advances. Consequently, in a time of rapid technological change like the present, there is a serious danger that the quality of the service provided by the carrier would fall far below that which the state of the art could provide.

(7.) Integrated Network of Telecommunications/Computer Utility Carriers

There are many different forms which this policy could take. All options, however, have the following parameters in common:

(a) The industry would be divided into a "Telecommunications /Computer Utility Carrier" and a "service" sector, as for Policy 6 and as defined in Part I.

(b) Both the telecommunications carriers and any other organizations that so desired would be permitted to supply raw computer power as previously defined, but only the offerings of the telecommunications carriers would be regulated.

(c) All telecommunications facilities, wide band cable and microwave distribution systems, as well as conventional record and voice would become the sole monopoly of the existing regulated telecommunications carriers.

(d) The telecommunications carriers would be forbidden as carriers, i.e., horizontal integration, from participating in the service sector but conceivably, as in option E of Part VI, could do so via an arms length corporate affiliate.

(e) A national integration body, (CCCA) as described in Part IX, would be established to integrate the operations of the different carriers, establish common standards, provide R&D and accomplish overall system planning for the total national network.

Claimed Advantages of Policy Group 7

1. Monopoly status applies only to that area of the industry where there is strong evidence that competition would result in poorer or more costly service than regulated monopoly, i.e. communications.

2. By including the wide-band distribution systems under the carrier umbrella, we ensure that wide-band systems (currently exemplified mainly by CATV, but potentially capable of providing dozens of additional two-way services) will be integrated into the regular telecommunications networks and costly duplication of services thereby avoided.

3. The problem of carrier discrimination is eliminated.

4. Cross-subsidization by the regulated carriers of unregulated areas such as the service sector, if not completely eliminated, is at least made very difficult.

5. The public interest is safeguarded and integrated planning and design of the overall system is assured through the national integrated body.

6. By not excluding any qualified Canadian organization from supplying raw computer power to the network, the fullest possible utilization of the nation's computer power is assured. The element of competition that would exist among the many suppliers would also encourage innovation in the introduction of new technologies.

7. The capital requirements for entry into the service area would be very low. Thus, the number of service retailers and, consequently, the range of services offered could be indefinitely large.

8. The presence of free competition in the service area would encourage innovation.

9. A wide area of capital support would be available.

Claimed Disadvantages of Policy Group 7

1. It is unfair to carriers to prevent them from entering the service area while existing computer utilities are permitted to provide both services and raw computer power.

2. New legislation and agreement of certain provinces would be required in order to fully implement the policy. This is particularly true of the cable TV field where there is currently no federal jurisdiction over closed circuit operations if they are not provided by a federally regulated carrier.

3. The carriers and others have expressed strong doubts as to the commercial viability of the "Purveyor of Raw Computer Power Concept". Consequently, there is reason to doubt the willingness of the carriers to participate on this basis.

4. Although the national integration body might help matters, giving the carriers a total monopoly of all communications, voice, record, data and video could slow down the development of a national digital network by overtaxing their resources and removing competitive pressures.

(8.) Integrated Network of Computer Utilities - The Trans Canada Computer Network.

Under this policy, a national data communications network would be created under one of the policy options discussed in Part VII. Depending upon the selected institutional arrangement the telecommunications carriers would participate either totally or partially in the construction and operation of this network, but they would be barred from providing public data-processing services including both raw computer power and application services except perhaps through a totally arm's length affiliate.

The data communications network would link together every publicly accessible remote data bank and information processing organization in the country so that together they would comprise the TRANS CANADA COMPUTER NETWORK. This network would operate under the overall guidance and planning authority of the proposed Canadian Computer/Communications Agency mentioned in connection with Policy Group 7 and discussed in detail in Part IX. Possible functions for this body could include: broad overall planning for the national network; establishment of common standards, providing for the necessary R&D, providing subsidies where necessary for hardware and software development and facilitating the integrated operation of the many different independent organizations and functional elements that would make up the network.

Other features of the policy include:

1. The term "Trans Canada Computer Network" is not meant to imply the existence of any formal organization by this name. Indeed the network would consist of hundreds or even thousands of completely independent organizations representing the full spectrum of institutional structures from government and crown corporations to independent data-processing companies. Their only common denominator would be the fact that they all utilize the service of the national data communications network and follow the general standards and guidelines set by the Canadian Computer/Communications Agency.

2. A major goal of the Canadian Computer/Communications Agency would be to provide every user everywhere in Canada with convenient access to the widest possible range of data-processing and data bank services. Consequently, it would encourage such measures as:

(a) Performance by the national data communications network and/or the individual carriers of the merchandizing functions for computer services described in connection with carrier data-processing policy option G.

(b) Implementation wherever possible of blanket agreements between the national data communications network and the data-processing organizations so as to minimize the need for special connect charges and long term contractual agreements between users and suppliers.

(c) Techniques such as those being pioneered by the ARPA Network in the United States to permit flexible interchange of programs and data among data-processing organizations and in particular to facilitate the movement by users of their data and programs from one data processing organization to another.

(d) Transaction and other flat rate tariff schemes.

(e) Realistic data-processing and communications standards.

(f) Nationally applicable mechanisms for the protection of privacy.

3. All users would be free to utilize either carrier supplied terminal equipment or their own equipment provided in either case it was properly certified by the appropriate national standards body, possibly the CCCA.

4. The national data communications network and its component elements would be required to meet all reasonable demands for service; to follow the overall plans established by the CCCA; to secure approval from the appropriate Federal Regulatory Body for tariffs, capital budget, rate of return, corporate structure, and general operating practices, procedures and regulations; and to purchase all major equipment and supplies by open competitive bidding.

5. The data-processing industry would be unregulated except with respect to basic standards, privacy, file protection, liability etc.

Claimed Advantages of Policy Group 8

1. It ensures that Canada will have a modern, economical national digital communication network capable of supporting the growth of a viable national computer utility industry.

2. It ensures that the benefits of computer power will be equitably distributed everywhere in Canada.

3. The public interest is safeguarded and integrated planning and design of the overall network is assured through the national integrating body.

4. It recognizes the diversity and competitive nature of the data processing industry by leaving it unregulated except with respect to basic standards, privacy, file protection, etc.

5. It provides a realistic framework for the optimum development in the public interest of a wide range of national computer services.

6. The policy recognizes and is fully compatible with the diversified ownership and regulatory pattern of the Canadian Telecommunications industry and ensures full representation for both federal and provincial interests.

7. It recognizes the "natural monopoly" status of telecommunications and the likelihood that in the Canadian context, competition in public data transmission would result in poorer or more costly service than regulated monopoly.

8. By excluding the telecommunications carriers from public data-processing it eliminates all of the vexing problems that result when a regulated monopoly participates in a competitive unregulated market.

9. It encourages the growth of a diversified Canadian terminal industry.

10. It provides computer users with freedom to choose the terminal that most closely meets their requirements but at the same time protects both the integrity of the communications network and other customers.

11. Since the network is all digital, modems are not required and this results in substantial savings for both customers and data-processing organizations.

12. It makes available a diversity of sources of capital.

13. The construction of the network would provide a major stimulus to both the Canadian electronics and remote data-processing industries.

14. It provides needed capital for development of Canadian software and support of the Canadian industry as well as for the support of services in areas of the country where the immediate economic returns to private investors might be unattractive.

Claimed Disadvantages of Policy Group 8

1. By excluding the carriers from the public data-processing area it eliminates a major potential source of capital from an industry that currently suffers from a shortage of working capital.

2. Large infusions of government capital might be required.

3. New legislation and co-operation of certain provinces would be required to fully implement the policy.

4. The proposed merchandizing function for the data communication network and/or telecommunications carriers has been critized as being unrealistic.

PART IX

Co-ordination and Regulation

1. A Major National Program

The size and complexity of the task Canada faces if her citizens are to benefit fully from the new levels of productivity and intellectual achievement promised by computer utilities implies a focussing of national purpose, creativity and capital into a co-ordinated effort. If most of the promises are to be fulfilled and the majority of dangers avoided, something more imaginative than either total laissez-faire or traditional regulatory restrictions will be needed.

So far we have spoken of systems open to diverse contributions and uses as merely something desirable. But the creation of national systems on the scale and of the potential described in this report appears economically and politically impossible without a concerted effort from the broadest possible base, working within the context of well defined national objectives. The magnitude of the task puts its realization beyond the reach of any single segment or small group in Canada.

It has therefore been suggested in the preceding chapter of this report that the Government of Canada serve as the focal point for a combined effort which might involve governments, computer companies, common carriers, universities, and major users, both actual and potential. This effort, expressed in appropriate institutional form, could examine, and where necessary use, such devices as standardization, coordination, rationalization, joint public-private ventures, and incentives to promote research and development.

Careful attention would have to be paid to the institutional character of any co-ordinating body, its composition and its terms of reference. For while specific programs could be administered by appropriate governmental agencies, a much larger body of opinion and expertise would be essential in examining such questions as the selection of computer services for meeting specific problems; the commercial practices of the computer/communications industry, including charging and costing formulae used in the trade; the inter-connection of computer and communication services and particularly the equipment and technical criteria so that large-scale information systems can be effectively utilized.

Among objectives which could be the concern of a national cooperative undertaking are:

-- The definition of those Canadian social and economic needs which can be fulfilled by an integrated national computer/communications system or systems;

-- The creation, with the assistance of public policies as needed, of systems and programs designed to assure the equitable distribution of computer power across Canada and its availability to the maximum possible number of individuals and institutions.

-- The encouragement, by means of appropriate programs, of research and innovation within Canada in the application of computer/ communications technology and systems.

-- The elaboration of policies, public and private, to prevent essential computer and data-processing services from coming under foreign control; to encourage the extension of services and systems on an east-west rather than north-south axis, and to assure that essential computer centers and data banks are established within Canada rather than beyond its borders.

-- The definition of criteria to be applied to the development of computerized information services and data banks utilizing communication links.

Any discussion of how Canadian national purpose is to be brought to bear on solving the problems of computer utilities might usefully examine the concept outlined by the Science Council of Canada's report entitled: "Towards a National Science Policy for Canada". In this important study on the future of Canadian science, the council introduced the concept of "Major Programs". Such programs were defined as "large, multi-disciplinary, mission-oriented projects having as a goal the solution of some important economic or social problem" and were justified as follows:

"A most important, but by no means sole, reason for the major program approach to organization is that it seeks to provide a national focus for efforts aimed at solving national problems...

"Many other arguments can be advanced in favour of the major program approach. First, a concerted, co-ordinated and co-operative program is the most efficient way to make progress toward the solution of large-scale practical problems where many technical disciplines are involved. Traditionally, research and development for the needs of national defence has been carried out on a national scale, and no one would suggest that it would be effectively accomplished by leaving it to small-scale efforts by local units. ...... Today it should be a measure of a nation's maturity that it can apply its problem solving resources on the national scale to progress on matters affecting the public interest other than the defence of sovereignty by military means.

"A major program approach is also called for by the increasing degree of organization that technological advance brings to society. In the past, problem-solving could be piecemeal, the goals of society were those of the individual and the more government stayed aloof the better. Nowadays, with the gathering of people into urban concentrations, with the high degree of interdependence created by technology and with increasing demands for efficiency in transportation, communications, energy supply, manufacturing, distribution of food and goods, waste disposal, etc., society has closed in upon itself. One man's effluent is another man's intake. It has become clear that there is a public interest which is not always coincident with or optimized by the pursuit of private interests..... A total 'systems approach' may be essential."

The main thrust of the Science Council Report was directed towards the growth and development of Canadian science and technology but the arguments in favour of the "Major Program approach" apply just as strongly to any large national undertaking involving many diverse disciplines and, in particular, to the creation of an integrated national complex of computer utility networks.

2. A National Co-ordinating Agency

In the discussion of overall Policy Options 7 and 8 in the preceding chapter, the term Canadian Computer/Communications Agency was used to describe a possible Federal Government organization that could coordinate the activities involved in a major program to assure the development in the public interest of an integrated Canadian Computer/Communications network. There are many different forms that this Agency might take and a corresponding range of different activities in which it could engage. Regardless of its precise nature, however, it is important to note the salient fact that the Agency would be a coordinating and catalytic agent rather than an operator of systems, a regulatory body or even the principal source of funds.

In order to properly meet the obligations discussed in Part VIII such an Agency would of course require substantial financial resources but they would represent only a small fraction of the tens of billions of dollars that many authorities feel will be spent during the decade on computer/communications equipment and services. In this connection it was assumed in Options 7 and 8 that most of the funds for the program would be supplied by private industry and the telecommunications carriers, augmented where necessary by various federal, provincial and municipal government departments, and perhaps some special Crown Corporations or Telesat-like organizations established to build and operate certain critical national services.

In fact, even though some of the figures mentioned in Part V of this report appear enormous by current Canadian standards, it must be remembered that a project of this magnitude could have a boot-strapping impact on the whole economy. Further, as the national system came into existence, its productivity multiplying features could be reflected in the form of a major increase in the gross national product. Consequently, investments that loom very large in 1970 could seem relatively trivial by 1980.

Functions of Agency

The "Core Functions" in which it has been suggested the Agency might be involved include:

-- Planning
-- Research and Development
-- Standardization
-- Licensing of Attachments
-- Financial and Technical Support.

Planning

The planning function would be central to all of the Agency's activities and, broadly stated, would involve the development of overall plans for the timely provision and optimum utilization of computer/communications facilities and services in the interests of the Canadian people. The perspective for such planning would be one which viewed the totality of the nation's telecommunications and computer resources as a basic ingredient of the nation's wealth and one of the principal determinants of national development. Consequently, in its planning role, the Agency would be charged with very broad responsibilities, including:

1. Analyzing and forecasting Canada's national needs for computer/communications services;

2. Forecasting the probable development of technology and analyzing the sociological and technical impact of new developments;

3. Designing in broad outline the national computer/communications networks required to meet the national needs; and preparing and updating as required the National Computer/Communications Master Plans.

4. Developing the required economic, regulatory and legal measures required for realization of the planned networks.

Research and Development

In the high technological content industries that are the building blocks of the emerging post industrial society, the crucial role of research and development is now well recognized. In fact, in his provocative book "The American Challenge", J.J. Servan Schreiber draws a direct correlation between economic progress and R & D, and shows that the lengthening gap between American and European industry is reflected in a startling difference in R & D expenditures. According to Schreiber, in 1966 for example, the U.S. spent $94. per capita on R & D, compared to $25. in Europe. Corresponding OECD figures for Canada and the U.S. reveal a similar gap. Thus in 1967, the per capita U.S. expenditures were $110.5 and only $32.0 for Canada.

Schreiber also reveals some startling figures for government expenditures in those industries in which the U.S. has developed an overwhelming world lead. These show that, in the Aviation and Spacecraft areas, the government financed 90% of the research and, in the Electrical and Electronic industries, 65%. He also compares two typical French and American Electronic firms with annual sales of $1.7 million and $23 million respectively. In the case of the American company, the research budget was $2 million of which the government financed $1.2 million, while for the French firm, the corresponding figures were only $80,000 and $16,000 respectively.

Although the large military content of the American figures does distort their significance somewhat, the fact remains that the world's high technology industries are largely American dominated. This fact is particularly relevant to the subject matter of this document for it is difficult to envisage an area having a higher technological content than that of modern computer/communications systems. Consequently, if Canada is to mount any sort of meaningful effort in the field of Computer Utilities, it may be necessary to substantially increase our research and development expenditures.

In this connection, a Canadian Computer/Communications Agency could be deeply involved in R & D. This involvement could take many different forms, including in-house work, industrial contracts, university and not-for-profit contracts, and grants to individuals and organizations. In fact, it might be desirable that the Agency employ all of these different mechanisms.

Standardization

One of the most important obstacles to the realization of interconnected national networks on the scale implied by this paper is the chaotic standardization situation in the computer industry. The situation pervades all aspects of the technology; data transmission, internal operating codes, word lengths, input/output interface standards, etc., and the entire field of software. In one sense, this lack of standards is a tribute to the dynamic character of the industry and, in particular, to the astounding rate of innovation that has been its most memorable feature. Consequently, it would be tragic if attempts at the premature imposition of standards were to inhibit such innovation in the future. On the other hand, there are many areas where reasonable standards could result in substantial economies and better service with minimal impact upon innovation.

There are, of course, many different ways in which standards could be established in the computer utility industry. Trade associations, professional societies, government and international bodies of all kinds and even powerful corporations can play important roles. In Canada, however, the proposed Agency could provide a natural focal point for channeling the views of these diverse interests and setting national standards for both computers and communications.

Licensing of Attachments

It was suggested in Part VII that the problems associated with the interconnection of terminal devices to the carrier networks (the foreign attachment issue) might be resolved by the creation of a neutral licensing body. All organizations, including carriers, would then have to secure the approval of this body before offering their devices to the public. The Canadian Computer/Communications Agency would be a possible choice for this body as the approval and licensing of attachments could be regarded as a natural extension of the Agency's standardization activities.

Financial Support

In addition to the previously mentioned financial support of Research and Development, the Agency could provide a number of different forms of direct and indirect financial support to the industry. Some of the possible forms are:

-- Subsidies to selected industries or organizations to encourage particular developments, finance new construction or lower rates;

-- Grants to help support socially desirable initiatives like new industries, data centers and cable or satellite TV facilities in underdeveloped areas; educational, medical and consumer information systems, etc.;

-- Low interest rate loans to encourage development during tight money periods or when rates of return are too low to attract private funds;

-- Scholarships to encourage deserving individuals to seek careers in the new computer/communications industries and thus help alleviate the probable shortages of trained manpower. These could also be used to help retrain people displaced by automation.

Technical Support

One of the most valuable functions that the Agency might perform would be the provision of technical assistance in the form of advisers, consultants and special training courses to help both organizations and individuals exploit the new computer/communications services.

3. Regulation for Innovation

In order to successfully complete a national program of the scope discussed in this report, it has been suggested that a new approach to regulation may be required. This approach might be termed "regulation for innovation" in contrast to the historic "corrective or reactive" form.

In the conventional approach, the regulatory body usually remains passive until complaints of poor service, discriminatory treatment or high rates, on the one hand, or proposals for new services or higher tariffs, on the other, force the regulators to take some action. This process may have been moderately acceptable in times of slow technological change, although even this seems doubtful when one remembers the conservatism and charges of conflict of interest that have historically plagued the regulation of public utilities. In the current situation, when we are faced with continuously accelerating change, however, it can be argued that such an approach is quite inadequate; that we need to emphasize flexibility and dynamism and, instead of blindly reacting to events, should seek to channel the forces of change along socially constructive paths.

Consequently, proponents of this new approach feel that whatever regulatory bodies are established for the computer/communications field should be involved in functions that extend far beyond the bounds of classical public utility regulation. Quality of service, need for capital for the provision of certain socially desirable services, rate of innovation and social need, for example, are claimed to be as important as the historic rate of return on invested capital in determining rates. The regulatory body or perhaps the proposed Computer/Communications Agency, it has been suggested, might also have funds available which it could employ as subsidies or low-interest loans to keep rates down and still encourage innovation.

Of course, the adoption of the "regulation for innovation" concept would not mean that the historic forms of regulation would disappear. Quite the contrary, telecommunications rates and services, as well as allowable rates of return, could be controlled as rigorously as they ever were in the past, although hopefully, more flexibly. In addition, any new carrier offerings, like raw computer power and wide-band (CATV) distribution systems, might also have to be tariffed. Further, when it comes to the protection of privacy and file integrity, ensuring freedom of access and prevention of censorship, it is possible that many other organizations, in addition to carriers, could find segments of their businesses beneath the regulatory umbrella.

4. Operation of Facilities

In the postulated Trans Canada Computer network, it is likely that the various facilities would be owned and operated by many different types of organizations representing, in fact, every segment of our pluralistic society. In this connection, certain facilities might very well be run by the Federal Government. A special Agency or Crown Corporation, for example, might be authorized to operate certain facilities or systems to provide suitable "yard sticks" for establishing rates and performance standards in private sectors of the industry. Such an organization

or organizations might also operate particular systems of critical national importance, a medical information system, sensitive data banks or government data-processing complex for example, or systems in under-developed parts of the country where it might be difficult to attract private capital.

5. Computer/Communications Task Force

On November 27, 1970 the Honourable Eric Kierans, Minister of Communications, announced the establishment of a major task force to investigate the whole question of computer/communications interaction in Canada, including the many issues raised by this report.

The principal task assigned the Task Force is to speedily develop and recommend specific policies and institutions that will ensure the orderly, rational and efficient growth of combined computer/communications systems in the public interest. The Task Force will be expected to produce definite recommendations and firm plans -- technical, financial and institutional -- relating to an integrated network of Canadian computer utilities.

A detailed description of this Task Force is contained in Appendix E.

GLOSSARY OF TERMS

GLOSSARY OF TERMS

ALGOL

An acronym standing for Algorithmic Language. A special language created by an International Committee in 1958 and intended to become the standard international language for scientific processing.

APPLICATION SERVICES

A general term for the various tasks that a Computer Utility might perform, for example, payroll processing, information retrieval, invoicing, process control, etc.

APPLICATION SOFTWARE

The special programs which serve to organize the raw computer power provided by a computer so that it is able to perform application services.

ARITHMETIC UNIT

That part of a computer which performs arithmetic operations, i.e. addition, subtraction, multiplication, and division.

ARPA

An acronym standing for the Advanced Research Projects Agency of the U.S. Department of Defense.

ASSEMBLER OR ASSEMBLY ROUTINE

A special program which makes it possible for a computer to accept a set of instructions written in nonmachine language, translate them into machine language, and then assign them to appropriate memory locations.

BANDWIDTH

Bandwidth is the difference between the limiting frequencies of a continuous frequency band.

BATCH PROCESSING

A method of processing in which a number of jobs are grouped and processed sequentially during the same computer run.

BINARY

Pertaining to a system with only two possible states, i.e. ON or OFF, often designated by 0 and 1.

BIT (Binary digit)

One of the two digits in the representation of data in a binary system, i.e., 0 and 1.

CARRIER

A person, usually a company or corporation who for hire conveys between the points of origin and reception, intelligence communicated by wire, radio, optical or other electromagnetic systems.

Carrier is also used to describe a signal which is used to carry intelligence by being suitably modulated, or impressed, by it. Carrier communication is also used to describe the technique of transmitting one or more messages over a single open-wire pair, cable pair or radio circuit.

CATV (Systems)

The term "Community Antenna Television (CATV or Cable Television) System" means any communications facility which makes use of wire, cable or other transmission line installation to distribute, to subscribing members of the public, signals which it receives either directly or indirectly over the air from television broadcasting stations. The system may also carry signals which originate in studios other than those associated with TV broadcasting stations, or which are received from FM or AM sound broadcasting stations.

COAXIAL CABLE

A transmission line in which one conductor is centered inside of a metallic tube that serves as the second conductor. Commonly used for the transmission of radio frequency signals over relatively short distances. Also used as the transmission means for undersea or overland multi-channel communications systems.

COBOL

An acronym for COmmon Business Oriented Language, a standard language for programming business problems, developed by the Committee on Data Systems Languages of the U.S. Department of Defense in 1959.

COMPILER

A special program which makes it possible for a computer to accept a set of instructions written in nonmachine language as with an assembler and produce as an output a machine language program in which many of the original instructions are replaced by complex sequences of machine instructions called subroutines.

COMPUTER

A device which can store and process and make available information which has been entered in either digital or analog form, e.g. digital computer, analog computer.

COMPUTER CENTRAL PROCESSING UNIT

That part of a computer which processes the information.

CROSS-SUBSIDIZATION

In the context of the telecommunications industry refers to the allocation of cost prior to deriving any rates and represents the influence of other segments of the business on the particular segment of the business for which the rates are being derived. In particular, relates to the sharing of the costs of providing service between relatively lucrative and less or non-lucrative areas of operations in order to offer a common rate schedule.

DATA

Information of any kind but generally, in communications, refers to digital data which is information represented by a code consisting of a sequence of discreet elements.

DATA BANKS

Refers to any central storage of information but is commonly used to refer to related information stored in a computer, e.g., legal data bank, medical data bank.

DATA-PHONE

The name applied by AT&T to the members of a family of devices used for providing data communications over telephone lines.

DATA TRANSMISSION

The transfer of digital information between two or more points via a communication system; radio, cable, wire.

DIGITAL

Pertaining to a system in which the message elements are evaluated in terms of discreet levels or values, and these are represented by a limited set of numbers or digits, e.g. 0 to 9 in the decimal system; 0 or 1 in the binary system.

DIGITAL COMPUTER

A computer which operates with information that is represented in digital form, i.e. in discrete as compared to the continuous form used in an analog computer.

EFFECTIVE RADIATED POWER (ERP)

In a transmitting system, the power of the transmitter multiplied by the gain of the transmitting antenna.

EXECUTIVE

A special program responsible for supervising the operation of a real-time computing system. It must handle input/output, allocate storage, establish priorities, keep track of work in progress, and activate the various operational programs.

FILE

An ordered collection of information.

FLIP-FLOP

A bistable device having two input terminals. It can be caused to switch from one state to the other by application of a signal to the appropriate terminal.

FM RADIO

Radio transmissions utilizing a method of modulation in which the frequency of the carrier is varied in frequency according to the amplitude of the information transmitted.

FORTRAN

An acronym for FORmula TRANslation, a language and compiler for handling scientific problems, developed by IBM.

FOREIGN ATTACHMENTS

A term used to describe equipment, i.e. telephones, modems, data sets, displays, etc., connected to a telecommunications carrier's facilities but which is not supplied by the carrier.

FREQUENCY DIVISION MULTIPLEXING (FDM)

The process of transmitting two or more messages or signals simultaneously over a common path by employing a different band for each signal. See Time Division Multiplexing.

FULL DUPLEX

Term applied to a communication channel over which both transmission and reception are possible in two directions at the same time.

GENERAL-PURPOSE COMPUTER

A computer which can be programmed to solve a wide variety of different problems whose nature may not even be known to the original machine designers.

GEOSTATIONARY

Stationary with respect to a point on the earth's surface. Thus a geostationary satellite is one located over the equator at a height such that it orbits the globe in the same direction and at the same rate as the earth rotates so that it remains directly above a given point on the earth's surface.

HALF DUPLEX

A term applied to a communications channel over which both transmission and reception are possible but in only one direction at a time.

HARDWARE

The electrical, electronic and mechanical devices from which a computer is constructed.

HORIZONTAL DIVERSIFICATION

A term applied to an organization, i.e. a telecommunications carrier which enters a business different than its normal field by integrating the new activities into the original business organization.

INSTRUCTION

A special code which causes a computer to perform a certain operation.

INSTRUCTION REPERTOIRE

The list of all of those instructions for which wired-in circuitry is provided in a computer.

INTERCONNECTION

A term used to describe the connection between different telecommunications carriers and/or telecommunications carriers and private systems so that signals pass freely from one system or carrier to the other.

INTERFACE

The boundary between two systems, subsystems, or devices.

INTERPRETER

A special program which translates an instruction written in a pseudo code into a machine language instruction and then directly executes that instruction.

LANGUAGE

Any communication code containing a defined set of characters together with the combinatorial rules for forming words or sentences, e.g. English, Russian, ALGOL, FORTRAN, French, Esperanto, COBOL, etc.

LARGE-SCALE INTEGRATION (LSI)

A technique used to produce microelectronic components which contain a large number of circuit elements on a single surface (Chip). LSI refers to any whole-function subsystem on a single chip capable of operating independently of other parts of the system. LSI devices are also used for memory systems.

LASER (Light Amplification by Stimulated Emission of Radiation)

A device for the generation of coherent light energy which results in very intense and sharply defined beams.

LIBRARY

A collection of programs and subroutines for solving problems of many different types.

MACHINE LANGUAGE

The language employed by the computer in its internal operations and thus directly intelligible to the computer's control section.

MASS STORAGE SYSTEM

A high-capacity storage system, external to but under the control of the computer, used for the storage of bulk data such as tables, files, and subroutines.

MASTER/SLAVE SYSTEM

A system in which one computer exercises control over the activities of another computer. Usually the "master" machine controls input and output, and schedules and supplies jobs to the "slave" machine. The slave computer is, in general, the one with the greater capability, and it performs most of the computational tasks.

MESSAGE SWITCHING

The operational procedure of receiving a message at an intermediate point, storing it until the proper outgoing line is available, and retransmitting it.

MODEM

An abbreviation used to designate units or equipment panels containing both a modulator and a demodulator.

MULTICOMPUTER SYSTEM

A computing system containing two or more simultaneously active computers.

MULTIPLEXING

The act of combining signals for many different sources into a common channel. This function is often performed by a multiplexor.

MULTIPLEXOR

A device, often a stored-program computer, which handles the input/output functions of an on-line computing system having multiple communication channels.

OFF LINE

1. Term applied to a system which does not process its input data as they are received but instead stores and processes them at some later time.

2. Also applied to auxiliary equipment, input-output devices, etc., which do not operate under the direct control of the central processing unit.

ON LINE

1. Term applied to a system in which input data are processed as they are received and output data are transmitted immediately as they become available to the point where they are needed.

2. Also applied to auxiliary equipment, input-output devices etc., which operate under the direct control of the central processing unit.

OPERATING SYSTEM

A special program which permits the automatic running of many different programs on a computer without operator intervention.

PULSE-CODE MODULATOR (PCM)

A system of modulation in which the message waveform is sampled at a prescribed rate and each sample is quantized and then coded in terms of pulses, where the height, width or position of a pulse has a definite code meaning.

PROGRAM

The group of related instructions which when followed by a computer will solve a given problem.

RAW COMPUTER POWER

The facilities portion of a Computer Utility. This includes basically the central hardware and executive system but might, in some cases, also include terminal equipment on the customer's premises and certain compilers and information retrieval control programs.

READ-ONLY MEMORY

A memory whose contents can be changed, if at all, only by off-line human intervention usually involving rewiring, the removal or insertion of plugs, or the punching of holes.

REMOTE ACCESS

Refers to a communication service which permits connection to a central facility from a remote point, generally via a telecommunication system.

SPECIAL-PURPOSE COMPUTER

A computer designed to solve a specific problem or class of problems.

STORAGE

1. A memory.
2. A general term for any device capable of retaining information.

STORED-PROGRAM COMPUTER

A computer which stores its instructions in the working memory and can operate on and modify them as though they were data.

SUBROUTINE

A sequence of instructions which cause a computer to execute some particular function not included in the computer's instruction repertoire. A program may contain many subroutines as well as normal instructions.

TIME-DIVISION MULTIPLEXING (TDM)

The process of transmitting two or more messages or signals over a common transmission path by allotting a different portion of time to each signal. Thus, the pulses from a number of channels are interlaced to form a single series of pulses.

TIME-SHARED COMPUTER

A computer which switches from customer to customer at a rapid rate under the control of a scheduling formula that in the simplest case is an ordinary round robin. Each user's program is thus run in the form of short bursts of computation, and all programs are time multiplexed together in a continuously repeating cycle.

VERTICAL DIVERSIFICATION

A term applied to an organization, i.e. telecommunications carrier, which enters a business different than its normal field by establishing a separate corporate subsidiary for conducting the new business.

WIDE BAND

A relative or qualitative term used as a general measure of bandwidth in terms of relatively narrow or broad. A spectrum of energy covering a wide frequency range. (For example, a single telephone channel would be considered as narrowband whereas a cable or microwave system would be considered as broadband.)

WORD

A group of characters or digits usually handled as a unit within a computer.

APPENDIX A

APPENDIX A

SUMMARY OF RESPONSES TO THE COMPUTER/COMMUNICATIONS INQUIRY

This appendix summarizes the answers received in response to a questionnaire that was mailed to interested parties in the Canadian Communications and Computer industries and to major users of computers and communications.

The questions asked were:

1. Should any telecommunication carrier in Canada whether subject to Federal or Provincial jurisdiction, be permitted to provide data processing services for users outside of its own organization.

2. Should any non-carrier data processing organization be permitted to provide communication services for users.

3. Define what are telecommunication services and data processing services.

4. Should a computer service subsidiary of a carrier be allowed to sell its services to the carrier which controls the computer subsidiary.

5. The circumstances, if any, under which any or all of the services indicated in items 1 and 2 should be deemed subject to regulation by an appropriate governmental authority and the nature of the enabling legislation, or, whether the policies and objectives of the Federal Government would be served better by such services evolving in a free, competitive market and if so, whether changes in existing provision or law or regulations are needed.

6. What new telecommunication and processing services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

7. In what respects and to what extent are present-day transmission facilities of common carriers inadequate to meet the requirements of computer technology, including those of accuracy, speed and bandwidth.

8. Does the computer utility as an industry fit the "natural monopoly" format that ultimately calls for regulation.

The questionnaire was sent out to 131 different organizations in Canada. They included computer manufacturers, data processing companies, major users of computers, and the telecommunications carriers. About 60 replies were received from the most interested organizations and users, including the major common carriers. Several companies chose to answer the inquiry through the Canadian Business Equipment Manufacturers Association Inc. which represents 72 major companies and which presented a substantial brief on their behalf.

The text of each of the responses will be made available at the time of publication of the overall Telecommission report on "Policy Considerations with Respect to Computer Utilities".

The following summaries attempt to organize, group and simplify all these views as accurately as possible without judgement as to their validity or justification.

As will be indicated, the responses are summarized here in a very different order to that shown in the terms of reference. The summary deals first with the problem of definition in question 3. It then groups the two questions (questions 1 and 4) concerned with whether telecommunications carriers should be permitted to operate data processing services and, if so, whether a computer service subsidiary of a carrier should be allowed to sell services to the controlling carrier. Next, the summary groups the responses dealing with the converse question of whether data processing organizations should be permitted to offer communications services. Following this are given the responses to two questions (questions 6 and 7) concerned with the anticipated communications needs of the computer industry and its customers and concerned with the present inadequacies of existing communications services. Finally, there are gathered together the responses to two questions (questions 5 and 8) regarding the necessity for and the nature of government regulation of the computer utility industry and the relationship between data processing and communications. Responses were received from the parties listed at the end of this Appendix.

Summary of Responses to Question 3
of the
Study of the Relationships Between Common Carriers,
Computer Service Companies and their
Information and Data Systems

Question 3: Define what are telecommunication services and data processing services.

Responses:

Most respondents provided sound definitions of telecommunications services and data processing services in many different terms. However, all answers but one were consistent with the idea that the two services are distinct. The answers may be summarized as follows:

Telecommunications Services

Telecommunications services provide the means for transmitting information, whether data, images or sound, from one location to another without substantial change being performed in the content or form of the information transmitted.

The Radio Act, Revised Statutes of Canada, 1952, Chapter 233, Section 2(i), as amended, defines telecommunications in this way:

> "The transmission, emission or reception of signs, signals, writing, images or sounds or intelligence of any nature by wire, radio, visual or other electromagnetic systems".

Data Processing Services

Data processing services are concerned with the translation of data into meaningful information and involve such functions as storing, retrieving, analyzing, classifying, correlating, sorting, summarizing and reporting information.

To illustrate the type of definitions received by the respondents, three examples from three different classes of respondents are given below:

User (Definitions proposed by The Canadian Bankers' Association)

Telecommunications Services - the transmission by wire or wireless of voice or data information between two or more points through a network of facilities usually controlled by common carriers.

Data Processing Service - receipt of information in human readable, human hearable, or electronic coded form, followed by the formation of, or updating of records, the processing of this data in accordance with user's requirements, and the subsequent provision to the user of the results of the information processing.

Data Processing Company (Definitions proposed by Computrex Computer Centres Ltd.)

A "Telecommunication Service" supplies lines and necessary switching equipment and in so doing provide no data conversion or processing. As a result, data sent into the line by a user is transmitted to another user, or to a branch of the data processing organization at a remote point from whence the data was initiated. Just as in a business conversation conducted by phone, the telephone service provides the phones and lines that make the transaction possible. The telephone service supplies nothing else.

A Data Processing Service is an organization apart from the common carrier in every respect. It operates on the data by means of a computer and outputs the data in a different form from input. Data is transmitted via a common carrier which enters and leaves the transmission system in the same unaltered form for processing remotely and the results of computer processing may by returned via a common carrier (or telephone service company).

Common Carrier (Definitions proposed by the Trans-Canada Telephone Systems)

Telecommunications services to represent a transportation of generic data via electromagnetic means.

We would, therefore, define data processing to be the manipulation of generic data, possibly changing it, in order to produce new information; where "new" is a value judgment of the user.

Summary of the Responses to Questions 1 & 4 of the Study of the Relationships Between Common Carriers, Computer Service Companies and Their Information and Data Systems

Question 1: Should any telecommunication carrier in Canada, whether subject to Federal or Provincial jurisdiction, be permitted to provide data processing services for users outside of its own organization?

Question 4: Should a computer service subsidiary of a carrier be allowed to sell its services to the carrier which controls the computer subsidiary?

Responses:

Broadly, the respondents who either favoured allowing the carriers to offer data processing or who saw no objection to such services included the manufacturers of computer equipment; some users in the pulp and paper, oil and of course, the carriers themselves. The major opponents of common carrier data processing services were the computer utility companies, the computer leasing companies, a few industrial users, and all but the one of the chartered banks. Two Federal Government agencies expressed reservations about the expansion of the carriers into data processing.

Many representations, both favourable and unfavourable, where stated subject to conditions or qualifications. For example, the Canadian Business Equipment Manufacturers Association - which, as noted, represents all major computer manufacturers - was willing to permit carrier data processing service subject to the following conditions:

(1) Operation of a common carriers data processing service by a separate and distinct subsidiary;

(2) Separate accounting and identification of joint costs shared by a carrier and its data processing subsidiary;

(3) Prohibition of the subsidizing of data processing subsidiaries by carriers;

(4) Non-discriminatory pricing and service by a carrier in the offering of communications facilities to its subsidiaries and to others;

(5) Curbing of disclosure by a carrier to its data processing subsidiary of information which the carrier has obtained from competitors of the subsidiary.

The Association also warned against the dilution by the carriers of the management and other resources available for providing telecommunications, and against the undertaking of undue financial risks by the carriers.

Respondents opposed to permitting carrier data processing services questioned fairness of permitting a carrier to build its data processing upon the base of a communications monopoly barred to its data processing competitors. One Government official compared this danger to "dumping" of excess capacity into Canada by foreign computer utilities.

Some respondents suggested that small data processing companies would be placed at the mercy of a large competitor providing a service essentially to them. Others wondered whether regulation could deceptively separate carrier revenues and charges from communications and data processing. In reply, the supporters of carrier data processing stressed the protection which could be provided by vertical separation of parent carrier communications and subsidiary data processing. They pointed to the advantages of more effective utilization of the computers required for communications, to the benefits of shared technology and to the value of using the expertise possessed by the carriers. Some suggested that carrier data processing would bring data processing services to small users to whom such services would otherwise be denied.

Summary of Responses to Question 2
of the
Study of the Relationships Between
Common Carriers, Computer Service Companies
and Their Information and Data Systems

Question 2: Should any non-carrier data processing organization be permitted to provide communication services for users?

Responses:

Because respondents seem to have interpreted Question 2 in different ways, it is difficult to provide a coherent summary of these responses. Some of the respondents interpreted the question as dealing with whether a non-carrier data processing organization or a group of such organizations should be permitted to establish a communications network independent of the existing common carrier facilities. Other respondents treated the question as dealing with the problem of whether a non-carrier data processing organization which leased communications facilities from a common carrier should be permitted to sublet those facilities to the data processing organizations customers. Still other respondents interpreted the question as concerned with whether a number of data processors could pool their communications needs by jointly leasing a communications facility from a common carrier and then subdividing it among themselves.

In addition a few respondents raised the issue of whether or not interconnection should be permitted between non-carrier data processing facilities and the public common carrier network. Several respondents also raised the issue of foreign attachments -- whether or not a non-carrier data processing organization should have the right to attach to common carrier facilities terminals, couplers or other devices not supplied by the common carrier.

Even among the respondent users of both data processing and telecommunications, opinions differed widely concerning the extent to which data processing organizations should be permitted to offer communications services.

In addition, an analysis of the responses to Question 2 is complicated by the close relationship between that question and Question 1. That is, a number of the respondents who argued in favour of permitting the data processing organizations to offer communications facilities appeared to do so on the assumption that the common carriers were to be permitted to offer data processing services. Thus, Consolidated-Bathurst Ltd. commented, "There seems little point in permitting a small restricted number of common carriers to offer Data Processing Services without permitting Data Processing Organizations to offer communication services."

Symbionics Systems Limited said, "If common carriers are allowed to provide data processing services then data processing organizations should be allowed to provide communication services." Whether these respondents would be willing to allow data processing organizations to provide communications facilities if the common carriers were precluded from providing data processing is not clear.

Affirmative Responses

Those respondents who favoured allowing Data Processing Organizations to provide communications facilities emphasized potential benefits to the public from increased competition and from specialized communications services. Imperial Oil Limited suggested that as a user, it would benefit from competitive services and would expect lower costs and more rapid introduction of technological developments. Canadian Industries Limited reasoned that if Data Processing Companies were permitted to provide communication services, this would foster economies of scale, would recognize the increasingly high proportion of communications used for data transmission and would provide a complete and efficient user service.

Chrysler Canada Limited responded "Yes" and noted that the computer service user would then be able to receive the benefits of data communications if he was unable to obtain his own facility.

The Ontario Paper Company Limited replied, "Data Processing Companies should be permitted to provide communication services if the customer so desires e.g. to obtain private communication to a central processor."

General Motors of Canada Limited replied "Yes, without restriction." The Ford Motor Company of Canada Limited suggested that Data Processing Companies should be permitted to provide communication services to their users, but that the communications should be limited to data processing applications. Ford pointed out that small users then could benefit from "packaged" options and from shared systems.

Noranda Mines Limited replied "Yes -- provided the communication services are leased from the common carrier."

MacMillan-Bloedel Limited stated, "We do not object to a non-carrier Data Processing Organization providing communication services for users" but added that rates for data processing and communications must be economically independent. Consolidated-Bathurst Limited would permit Data Processing Companies to provide communications services.

Collins Radio of Canada Limited distinguished between two types of communications services. The first, such as exchange telephone services, is in the public utility category and requires franchise protection. The other services are more private in nature and require neither dedication to public use nor public protection or privilege. Collins Radio would not limit private types of communication to franchised carriers.

Dow Chemical of Canada Limited replied simply, "Yes".

A number of responses suggested that data processing companies should be permitted to provide communications services subject to existing rules and regulations governing common carriers. The Canadian Business Equipment Manufacturers' Association took the position that a data processing organization should be permitted to act as a common carrier subject to existing rules governing entry into that business. C.B.E.M.A. noted, however, that a data processing organization which used telecommunications as an incidental part of providing data processing services would not be providing a telecommunication service, but rather a data processing service and, therefore, would not be a common carrier through this use of communications.

IBM Canada Limited agreed that any organization should be permitted to provide telecommunications services subject to general regulations. IBM added that a data processing company which provided common carrier communications should be required to offer its communications services to other data processing companies on a non-discriminatory basis. IBM suggested that data processing should be segregated from regulated communication services. IBM also noted that a data processing company which used a common carrier to provide communications ancillary to data processing should not be regulated.

Several respondents suggested that Data Processing Companies be permitted a limited right to provide communications services. Domtar would permit the provision of such services to users of the data processing facilities. Setak Computer Services Corporation Limited also would permit data processing organizations or groups of organizations to provide communication services for their own use but would not permit the provision of communications services apart from such data processing services since (Setak argued) this would foster monopoly. AGT Data Systems Limited again would permit data processors to purchase communications services and to share these with a few customers. Digital Analysis & Technical Assistance Ltd. argued that a data processing company should definitely be permitted to provide communications services provided "There is a data processing content in such communication services."

The response of Kates, Peat, Marwick & Co. was ". . . a qualified yes. Any organization...should be allowed to provide a dedicated leased network for a particular user company... . However, such an organization must not supply a switched network service to multiple users." The Kates firm also suggested that at one or more points on a private network a tie-in interface should be permitted to the common carriers switched network, subject to suitable technical specifications.

Computer Sharing of Canada asked that data processing companies be allowed to provide communication services for users so long as these services do not conflict with present common carrier business of general message switching and communications. Computer Sharing also made the permission to provide such services conditional on the inability of the carriers to meet such data processing requirements as an economical, commercial offering.

Greyhound Computer of Canada Ltd. would permit a data processing company to provide terminal-to-terminal communications as an aid to processing data -- for such needs as correcting programs or editing the data. But Greyhound added that users should not be provided with a means of circumventing normal communications channels for reasons unrelated to data processing. Greyhound noted that the use of a data processing company's computer facilities for routine communications would not benefit a computer utility since it involves high system overhead for the utility. Hence, Greyhound argued, the use of data processing communications facilities probably would be self-policing.

A significant argument in favour of permitting sub-leasing of communications was made by Gulf Oil Canada Ltd. Gulf commented, "The utilization of leased lines for data communication leads to extensive idle capacity which the users effectively pay for. For instance, if we could share time on a broadband link between Montreal, Toronto and Calgary either by subletting on our leased lines or buying time on someone else's lines, long distance transmission could become much more attractive to us and to other companies.

"The inability to sub-lease retards the growth of this function and results in economic waste through locked-in idle capacity."

A possible limitation on the communications service which might be offered by a data processing organization was suggested by Computrex Computer Centres Limited. Computrex suggested that even if a data processing company was not allowed to have a long distance communications network, the data processing company should be able to use new laser techniques or radar or an approved local microwave system within a city. This limited communications network might also include hard wire or coaxial cable within a building or city.

Negative Responses

As one might expect, the common carriers objected to the provision of communication services by Data Processing Organizations. The Trans-Canada Telephone System responded:

> The question as stated must be answered in the negative if the intent is that such service would be provided on a non-regulated basis. If the intent of the question is to enquire whether processing organizations should be permitted to set up regulated telecommunication subsidiaries (in effect set up additional communication carriers) then the following factors must be borne in mind:
>
> (1) It would result in proliferation of telecommunications facilities. Where two structures can transport the same data, duplication is wasteful of resources. The only exception is in situations demanding physical separation of structures for the purpose of improving and maximizing continuity of service under conditions of natural disaster or acts of war.
>
> (2) Telecommunications usage cannot easily be segregated and handled on separate facility structures. In general, the user wants to talk, hear, see, and interact with computers and humans. It would be hard to believe that the public could be best served by having to deal with one company for its voice communications, with another company for its data communications, with another company for its data processing communications, and with yet another company for its video communications, etc. The future need is for simultaneous voice, data computer and visual interaction.
>
> (3) There would be little justice in any arrangement whereby regulated carriers in meeting their charter obligations must provide services to all areas -- while data processing communications vendors could select and service profitable high volume routes; including the sale of voice and non-computer data communications. Further, if the "cream-skimming" were permitted to occur, costs to the public for other communications would of necessity increase since the revenue support for many existing structures would be considerably reduced.
>
> (4) The question implies that there are no economies of scale in existing telecommunications structures. Economy of scale, where expensive physical networks are required, is one of the basic raisons d'etre of telecommunications utilities. There is little doubt, in the case of general random access usage, that one facility carrying many services is more economical and efficient than several arrangements providing one service per facility.

(5) An affirmative answer to the question implies that the carriers need not concern themselves with new telecommunications needs. Growth markets are essential if the telecommunications carriers are to survive.

(6) Regulation of a multitude of carriers is far more difficult that regulation of a few.

(7) Frequency allocation for a multitude of carriers is more difficult than for a few.

CN Telecommunications argued that no more than the present number of carriers can be supported by the business in Canada. The company stressed the need to protect telecommunications investments and referred to the effect of lower interest rates upon communications costs. CN Telecommunications noted that data processing company communi cations services would need to be funded at higher interest rates than would such services from the carriers, thus increasing the cost to Canada.

CN Telecommunications emphasized the "cream-skimming" argument, pointing out that common carriers must serve light density routes as well as high density routes.

Both CN Telecommunications and CP Telecommunications noted the advantage of economies of scale. The CP Telecommunications response stated, "Provision of telecommunications services should be restricted to a minimum number of competitive carrier groups to provide economies of scale, efficient use of the frequency spectrum and competitive incentives."

The "cream-skimming" argument occurred again in the response from Computer Sciences Canada Limited, a firm controlled by CN/CP: "Localized competition would possibly reduce the cost of data communications in profitable urban areas but would lead to increased costs elsewhere or would lead to government subsidy of common carrier Computer Sciences Canada Limited denied the economic justification for a dedicated network for any data processing organization: "The total memory capacity of the approximately 2000 digital computers installed in Canada is estimated at 500 Megabits. One dedicated microwave link with a total transmission capability of 25 Megabits/second would be sufficient to exchange all information stored in the memories of all computers in Canada once every 20 seconds. This capability is orders of magnitude greater than any predictable requirement in the data processing industry."

The cream-skimming argument against data processing communications services was made by the Aluminum Company of Canada Ltd., as well as by the carriers.

The Canadian Bankers Association argued that where adequate common carrier communications facilities are available, it should not be necessary for a company engaged in data processing, such as a bank, to own and operate its own telecommunicatio facilities. The Association suggested that permission to establish private telecommunication facilities might be granted where required service was not provided on a satisfactory basis.

The Canadian Bankers Association also objected to sub-leasing of common carrier communications facilities by a user. The Bank of Montreal dissented on this point from the rest of the Association, believing that such sub-leasing should be allowed. The Bankers Association suggested that the carriers themselves should be allowed to lease communications facilities on a shared basis to two or more users.

Other arguments against permitting communications services by data processing companies were made by some users. A number of responses stressed the inefficiency of multiple communications systems. Cominco Limited replied, "No, since existence of two separate major telecommunications systems in Canada already creates problems requiring duplicate equipment at some points. Additional systems would compound this difficulty."

The Price Company Limited stated, "Non-carrier data processing organizations should probably not be permitted to provide communication services unless some means can be found to coordinate the various means of communication so that a high degree of efficiency may be maintained."

The reply of Cyanamid of Canada Ltd. stated, "No. Non-carrier data processing organizations should be permitted only to provide terminals and consulting services on a interconnection basis. It would be very difficult to service and to keep track of multiple suppliers."

RCA also favoured restriction of communications services to the common carriers to achieve "equitable and controlled services to any user."

One novel response was made by the Iron Ore Company of Canada, which returned separate responses from its activities as a common carrier and from its data processing department. As a common carrier, the Iron Ore Company favoured the joint operation of an over-all service by a data processing and communications organization. However, the data processing department argued that non-carrier data processing organizations should not be permitted to provide construction, operation or maintenance of outside physical plant. The data processing department warned against duplicate facilities and overcrowding of spectrums.

Summary of Responses to Questions 6 and 7 of the Study of the Relationships Between Common Carriers, Computer Service Companies and their Information and Data Systems

---

Question 6: What new telecommunication and processing services are or will be required to meet the present and anticipated needs of the computer industry and its customers?

Question 7: In what respects and to what extent are present-day transmission facilities of common carriers inadequate to meet the requirements of computer technology, including those of accuracy, speed and bandwidth?

Responses:

The answers received should be discussed from the point of view expressed by three groups of respondents: Users of Data Processing Services, Common Carriers and the Computer Services Industry. The Computer Services associated with Common Carriers have tended to express desirable development of transmission facilities rather than inadequacies of present facilities.

Users of Data Processing Services

The data processing services are provided to the users by the computer services industry at a cost and within the limits of the facilities available and they are more concerned with the quality and the cost of services offered to them than with the problems associated with the development of these services. They also are not giving too much thought beyond the services required for their immediate needs, and their general comments were the following:

a) Cost

- The cost of teleprocessing services is too high. Lesser expensive methods of data transmission are required because the transmission cost often exceeds the computer cost.
- Present and future requirements dictate the need for less restricted and less costly services (e.g. Bell Telephone W.A.T.T.S. requires that a single master station initiates all calls in the network).
- Shared switching services for data terminal as well as for administrative terminal are required.

- The demand from the carriers that a terminal connector or data set be installed at each end of the line as do the transmission/reception devices is most annoying.

- Rates of charges for items considered non-standard appear to be high and unrealistic in view of the cost of the item.

- Common carriers should be required to expand the schedule bulk rates for communications packages based on total volumes of data and total mileage of transmission against charges based on private line circuit mileage or switched network time usage.

- Users must often move to leased line in order to have suitable speed and bandwidth transmission characteristics, and a leased line often exceeds their usage time requirements.

b) Improvement to the Teleprocessing Services

- Need increased capabilities for transmission from 60-48,000 BPS.

- Additional higher speed transmission circuits in a variety of bandwidths are required in smaller areas (e.g. London, Sarnia) to enable computer to computer, computer to CRT and facsimile transmission.

- Need more medium speed channels (1200-9600 baud).

- Need more very low speed channels (less than 200 baud) at low cost.

- Need very high bulk telecommunication facilities between major population centre with connected processing services to store and re-route data across lower speed facilities to nearby plant, zone, region, district customer and supplier locations and offices.

- Need interconnection between the two major common carriers and between the common carriers and the other communication company in order to get greater area coverage and interface at remote distances.

- Legislation should be introduced to require common carriers to permit interconnection of their facilities within competing carriers or private companies.

- One company requires wideband facilities to remote areas like N.W.T.

- Greater effort is needed from the carriers to improve accuracy, reduce noise, both in data channel and in their switching centres.

- Implementation of self-checking transmission codes is vital.

c) Equipment

- No unnecessary restriction should be applied to the linkage between data processing equipment and communications equipment.

- Interconnection of the common carrier switched network system with foreign attachments and user provided communication system should be mandatory, provided equipment meets interface standards.

- Users should be protected against the use of restrictive policies for equipment by the common carriers.

- Delivery time for communication equipment from the carrier is significantly longer than those quoted by other suppliers.

- There is also a lack of compatibility between computers of different manufacturers and users tend to be "locked in" to a manufacturer through use of proprietary software.

- Greater effort should be made to design teleprocessing equipment compatible with telecommunications facilities. All new developments must be compatible with what exists and individual utilities must be compatible with one another to realize the full potential teleprocessing.

d) System Design

- There is a need for system design for data transmission.

- It is difficult to obtain competent technical guidance from the carriers with respect to data communications.

- Users demand appears to be inadequate for the common carriers to develop systems other than those available.

- Common carriers are not flexible in meeting the needs of new systems.

- Need increased effort by common carriers to educate and train their employees in the special requirements of data transmission.

Common Carriers

The Common Carriers seem to have a fairly optimistic view compared to that of the users of data processing services. One contends that it has not experienced significant complaints from the Computer Services Industry in connection with the quality of the services and that sparse information is available on the services required by the industry and on the present inadequacies of existing facilities. A second Common Carrier proudly advances that the telecommunications technology of the Canadian carriers is second to none and is constantly being improved. Common Carriers general comments are the following:

- New rate packages are being developed, designed to meet the new characteristics of computer oriented information systems. New applications of transmission and switching systems are being developed to offer such services as switched wideband data, picture phone, touch-tone for data etc., as well as the possibility of processing in transit.

- New technology is being introduced into a large network on a continuing basis. Transmission facilities can handle data from the lowest bit per second rate into the megabit per second ranges, i.e. voice to full broadcast video.

- Noise has been reduced and new systems (error checking) have arisen to cope with this problem.

- Traditional rate packages have been geared to meeting a low volume market but a series of new rate packages have been put into affect to satisfy the need for higher speeds on a dedicated facility basis.

- On switched networks, costs are set in this way: (a) establishment of connection covered on the basis of minimum charge; (b) toll rates are largely a function of time and distance.

- Telex switched network, there is no minimum charge. Savings are realized by the use of call metering instead of automatic call ticketing.

- It is not the practice of the carriers to establish rates which are related to the number of anticipated errors in transmission.

- Computer to Computer transmission is available on private line or network carrier services to meet the vast majority of needs.

- The need for a very high switching speed network is at this time vague in Canada.

- Computer to and from high speed terminal is part of carrier's present offering.

- One carrier agrees to permit interconnections of users equipment subject to maintenance of technical standards to protect the integrity of the system.

- The other feels that more effort is required in the design of data sets and remote terminal business machines.

- Better cooperation and planning is needed between users, computer suppliers and the common carriers.

The Computer Services Industry

The Computer Services Industry is almost entirely dependent on the telecommunications companies, primarily the common carriers because in most cases data must be brought back and forth to the computer centre over large distances via telecommunications networks. The industry is always on the lookout for new ways to process data at lesser cost and for the creation of new needs which enable it to remain competitive. Since all new services must be matched by improved facilities and more flexibility from the communication carriers, the Computer Services Industry feels oppressed by the policies and high rates imposed by the carriers, and they have this to say:

a) Cost

- Today's transmission facilities are too expensive for long distances. Off-peak use should be available for lower cost transmission.

- Common carrier tariffs should exclude the costs of common carrier provided terminal equipment.

- Common carriers should be forced to minimize artificial pricing structure. Users in remote locations have no incentive to install concentrators or FM multiplexors because of artificial prices imposed by the carriers.

- Rate structure may arbitrarily change and cause new equipment to be obsoleted a few weeks after the product is announced.

- Need a uniform tariff published and readily understandable by the user.

Communications Improvement

- Present day transmission facilities are adequate although by no means outstanding and they stand improvement.

- The 5 level code is inappropriate for data transmission and should be converted to a unified 8 level code (ASCII) to enhance the growth of computer utility.

- Current communications facilities lack transmission capability for effective intercomputer communications (2-3 Megabits per second) and for the development of distributed data banks.

- Need high speed in one direction with option to low speed in the other direction.

- Existing connection possibilities between users of the telephone network, including interoffice trunks are inadequate and not designed for the simultaneous access implied by share time usage in the home.

- To provide service to the widely separated population of Canada, there will be a requirement for a network system which will allow interconnection between low and high speed transmission.

On Common Carriers Policies

- Policies whereby user provided modems may only be used on the switched telephone networks through connector equipment provided by the telephone companies must be liberalized to benefit the majority of data processing users.

- Interconnection of common carrier leased and switched telecommunication services with privately owned communications services using privately owned equipment need to be allowed.

- Restrictions on switched network multiplexing should be abolished.

- Burden of proof of non-compliance with channel performance standards should rest with the common carriers.

- Attachment of data devices should be governed by published uniform technical specifications.

- Common carriers should allow the sharing of package offering by separate users in order to make economic facilities accessible to smaller members of the data processing industry.

Technical Specifications

- There is a need for increased dialogue and liaison between telecommunications carriers, the data processing equipment suppliers and the data processing services suppliers to:

  a) provide a basis for proper planning by all parties;

  b) provide for the proper design and construction of telecommunications-oriented data processing systems;

  c) provide a basis for the interfacing of user equipment;

  d) provide for less conflict due to technological differences of approach.

- Standards and methods for data transmission should be given a complete review with industry participation.

Security

- Effective techniques will be required in both communications and processing to prevent unauthorized access, limit authorized access and to detect the penetration of the security system.

- Adequate legal and administrative safeguards will also be required.

Summary of Responses to Questions 5 and 8 of the Study of the Relationships Between Common Carriers, Computer Service Companies and their Information and Data Systems

Question 5: The circumstances, if any, under which any or all of the services indicated in items 1 and 2 should be deemed subject to regulation by an appropriate governmental authority and the nature of the enabling legislation, or, whether the policies and objectives of the Federal Government would be served better by such services evolving in a free, competitive market and if so whether changes in existing provision or law or regulations are needed.

Question 8: Does the computer utility as an industry fit the "natural monopoly" format that ultimately calls for regulation?

Responses:

Because both Questions 5 and 8 were concerned with the extent to which the federal government should regulate either data processing or communications activities, the responses to these two questions have been treated together. Question 8 raised the issue of whether the computer utility could be regarded as a natural monopoly which required regulation in the same way as utilities such as electric line and power companies. Although a full response suggested that there was some possibility of such a monopoly emerging in the future, virtually all responses agreed that the present state of the Data Processing Industry did not justify regarding a computer utility as a "utility" in the judicial sense. Many responses emphasized that the Data Processing Industry is highly competitive and in no way monopolistic. Other points which were raised several times in response were the following:

(1) Entry into the Data Processing Industry is relatively easy.

(2) Capital requirements of the Data Processing Industry are low.

(3) The ratio of revenues to capital investment in the Data Processing Industry is comparatively high.

(4) The types of service which a computer utility may offer are so varied that it is likely that any single company can offer all types of services for which there is a demand.

(5) The demands upon the executive software of a computer and the costs of communication place a limit on the size of a computer utility which can be operated economically. This limit on the size of operation prevents any monolithic monopoly.

(6) The cost and quality of computer utility services are more dependent on the design of hardware and software than on the volume of business.

A very high proportion of respondents also emphasized the necessity of protecting a free and competitive market for data processing. Perhaps the strongest general impression which one obtains in reading through all of the submissions is an emphasis upon competitive free enterprise and a desire to hold government regulation to a minimum.

Several responses commented on the danges that any regulation might fail to keep pace with such a dynamically developing industry as data processing services. CN Telecommunications, for example, warned that the rate of development and innovation in data processing services is so rapid that it would be very difficult to formulate regulations which would remain meaningful for any length of time. Hence, regulations might interfere with the flexibility of the industry to keep pace with new development

Although virtually every response stated that regulation of the computer service industry is unnecessary, several responses mentioned that regulation would see appropriate concerning questions of security and privacy. The Trans-Canada Telephone System also mentioned specific action to provide certification of competence. TCTS added that regulation might apply rather than free competition in some cases where duplication of effort or lack of readily available data might adversely effect the Canadian economy. The TCTS brief referred to cases such as some national statistics, general medical information and perhaps legal data, and some credit information.

A few responses also suggested regulation to promote uniform standards. Imperial Oil Limited noted that controls and standards should be imposed on any interface with the public telephone and telegraph, so as to guard against interference. Canadian Industries Limited suggested that regulation might secure compatability among communication and data processing services. CIL urged standards to permit a user to move his computer system from one supplier of services to another.

Although Question 5 appeared to seek responses only on the extent to which communications and data processing combinations require regulation, a number of responses dealt with regulation of telecommunications more generally. Many responses indicated approval of the regulation of common carriers to insure standard published rates and non-discrimination among communications users. Consolidated-Bathurst Ltd. also noted that government regulation should insure consistency and uniformity where appropriate and should encourage the extension of services to parts of rural Canada where returns would not be immediate.

Some responses emphasized the value of requiring separate costing for the use of computers, and for the use of communications.

One brief, by Northern Electric, which proposed an extensive plan by which the common carriers would act as distributors of programs or information services on behalf of many others, suggested that regulation might govern the duty of the common carrier to act as a supplier on behalf of authors.

A number of comments on the regulation of the relationships between common carriers and data processors reiterated responses to Questions 1 and 2.

LIST OF RESPONDENTS

Aluminum Company of Canada Ltd.,
Box 6090, 1 Place Ville Marie,
Montreal 101, Quebec.
Attn: R.W. Callon,
Manager, Systems Development
Department.

A.G.T. Data Systems Ltd.,
74 Victoria Street,
Toronto 210, Ontario.
Attn: G.A. Wanless, President.

Alphatext Systems Ltd.,
233 Gilmour Street,
Ottawa 4, Ontario.
Attn: G.A. McInnes, President.

British Columbia Forest Products Ltd.,
1190 Melville Street,
Vancouver 5, B.C.
Attn: W.R. Steen, Comptroller.

Burroughs Business Machines Ltd.,
801 York Mills Road,
Don Mills, Ontario.
Attn: F.J. Matas, Manager,
Sales Promotion Group III.

Canadian Business Equipment
Manufacturers Association Inc.,
1 Greensboro Drive,
Rexdale, Ontario.
Attn: G.D. Wynd, General Manager.

The Canadian Bankers' Association,
P.O. Box 282, Royal Trust Tower,
Toronto 111, Ontario.
Attn: J.H. Perry, Executive Director.

Canadian Datasystems,
2055 Peel Street,
Montreal 2, Quebec.
Attn: H. Botting, Assistant Editor.

Canadian General Electric Company Ltd.,
214 King Street, West,
Toronto 129, Ontario.
Attn: J.G.P. King, Manager,
Information Services Business Sec.

Canadian Industries Limited,
P.O. Box 10,
Montreal, Quebec.
Attn: J.H. Shipley, Vice-President.

Canadian Petroleum Association,
151 Slater Street,
Ottawa 4, Ontario.
Attn: J.M. MacNicol, Manager.

Chrysler Canada Limited,
P.O. Box 60,
Windsor, Ontario.
Attn: H.J. Fyall, Manager,
Organization, Systems and
Data Processing.

Canadian National Telecommunications,
Room 301, Blackburn Building,
85 Sparks Street,
Ottawa 4, Ontario.
Attn: K.J. MacDonald, Manager,
Special Services.

CP Telecommunications
Suite 518, Place du Canada,
Montreal 101, Quebec.
Attn: R.E. Allen, Assistant General
Manager, Computer Services.

List of Respondents to the Inquiry (cont'd)

Collins Radio Company of Canada Ltd.,
150 Bartley Drive,
Toronto 16, Ontario.
Attn: G.J. Bury, Director of Marketing.

Cominco Limited,
1385 Cedar Avenue,
Trail, B.C.
Attn: J.E. Roberts, General Supervisor,
Data Processing Services.

Computer Sciences Canada Limited,
1200 Eglinton Avenue, East,
Don Mills, Ontario.
Attn: W.M. Richburg, President.

Computer Sharing of Canada,
4214 Dundas Street, West,
Toronto 18, Ontario.
Attn: B.A. Martin, Vice-President,
Technical.

Computrex Computer Centres Ltd.,
2000 Elveden House,
Calgary 2, Alberta.
Attn: G.M. Kernahan, P. Eng.,
President.

Consolidated-Bathurst Limited,
800 Dorchester Boulevard West,
Montreal, Quebec.
Attn: N.A. Grundy, Director,
Planning and Coordination.

Consolidated Computer Services Ltd.,
48 Yonge Street,
Toronto 1, Ontario.
Attn: M. Kutt, President.

Control Data Canada Ltd.,
50 Hallcrown Place,
Willowdale, Ontario.
Attn: W.G. Glover, President.

Cyanamid of Canada Limited,
P.O. Box 1039,
Montreal 101, Quebec.
Attn: J.R. Bruce, Director of
Data Processing.

Davis & Company,
Barristers & Solicitors,
14th Floor, Burrard Building,
1030 West Georgia Street,
Vancouver 5, B.C.
Attn: D.H. Paterson.

Domtar Limited,
Domtar House,
395 de Maisonneuve Blvd., West,
P.O. Box 7210,
Montreal 101, Quebec.
Attn: T.H. Lloyd, Director,
Computer Systems Development.

Dominion Bureau of Statistics,
Tunney's Pasture,
Ottawa, Ontario.
Attn: W.E. Duffett, Dominion Statistic

Digital Analysis & Technical
Assistance Limited,
510, 310 - 9th Avenue, S.W.,
Calgary, Alberta.
Attn: J. Duby, P. Eng.,B.Sc.,B.A.,
M.A., D. Phil.

Dow Chemical of Canada Limited,
P.O. Box 1012,
Sarnia, Ontario.
Attn: C. Taylor, Supervisor,
Communications & Services.

Ford Motor Company of Canada Limited,
The Canadian Road,
Oakville, Ontario.
Attn: B.P. Prince, Manager,
Communications and Data
Processing, Finance.

General Computer Corporation Ltd.,
885 Don Mills Road,
Don Mills, Ontario.
Attn: R.H. Parker, President,

List of Respondents to the Inquiry (Cont'd)

General Motors of Canada Limited,
Oshawa, Ontario.
Attn: A.I. Omand, Administrator,
Data Processing Department.

Geodigit,
Chevron Standard Building,
415 - 3rd Street, S.W., 3rd Floor,
Calgary, Alberta.
Attn: J. Merland, Manager.

Greyhound Computer of Canada Ltd.,
65 Adelaide Street, East,
Toronto 1, Ontario.
Attn: G.B. Clarke, President.

Gulf Oil Canada Limited,
800 Bay Street,
Toronto 5, Ontario.
Attn: D.S. Blackmore,
Coordinator - Systems.

Honeywell Controls Limited,
740 Ellesmere Road,
Scarborough, Ontario.
Attn: R.E. Weber, Director of
Marketing, Electronic Data
Processing.

IBM Canada Limited,
1150 Eglinton Avenue, East,
Don Mills 402, Ontario.
Attn: J.E. Tapsell, Office of the
Director of Data Processing
Communications Relations.

Imperial Oil Limited,
111 St. Clair Avenue, West,
Toronto, Ontario.
Attn: E.D. Kingsbury, Manager,
Systems and Computer
Services Department.

Interprovincial Pipe Line Company,
Box 398,
10015 - 103 Avenue,
Edmonton 15, Alberta.
Attn: C.H. Bucklee, P. Eng.,
Manager Engineering.

Iron Ore Company of Canada,
Sept-Iles, Quebec.
Attn: H.E. Farnam, Jr.,
Vice President, Operations.

Kates, Peat, Marwick & Company,
Prudential Building,
4 King Street, West,
Toronto 1, Ontario.
Attn: G.S. Collins, P. Eng.,
Partner, Electronic Systems
Engineering.

MacMillan Bloedel Limited,
1075 West Georgia Street,
Vancouver 5, B.C.
Attn: J.O. Miller, Director,
Computer & Operations Research Svcs.

Noranda Mines Limited,
Suite 1700,
44 King Street, West,
Toronto 1, Ontario.
Attn: A.H. Zimmerman, Vice-President-
Comptroller.

Northern Electric Company Limited,
P.O. Box 3511, Station 'C',
Ottawa, Ontario.
Attn: G.B. Thompson, Communications
Studies Group.

The Ontario Paper Company Limited,
Thorold, Ontario.
Attn: K.T. Waldock, Director,
Operations Research.

Olivetti Underwood Limited,
1390 Don Mills Road,
Don Mills, Ontario.
Attn: L. Amato, President.

List of Respondents to the Inquiry (Cont'd)

The Price Company Limited,
65 St. Anne Street,
Quebec 4, Quebec.
Attn: R.E. Membery, Vice-President, Finance.

Québec Téléphone,
Rimouski, Quebec.
Attn: Julien Thuot, L.S.C., C.Adm., Vice-President-Finance & Treasurer.

R.C.A. Limited,
1001 Lenoir Street,
Montreal 207, Quebec.
Attn: H.B. Godwin, Vice-President, Defence Systems.

Systems Research Group,
130 Bloor Street, West,
Toronto 5, Ontario.
Attn: R.W. Judy, Principal.

Science Council of Canada,
7th Floor,
150 Kent Street,
Ottawa 4, Ontario.
Attn: P.D. McTaggart-Cowan, Executive Director.

Setak Computer Services Corporation Limited,
20 Spadina Road,
Toronto 4, Ontario.
Attn: J. Kates

Systems Dimensions Limited
770 Brookfield Road,
Ottawa 8, Ontario.
Attn: G.A. Fierheller, President.

Symbionics Systems Limited,
550 Berry Street,
Winnipeg 21, Manitoba.
Attn: B.A. Hodson, President.

T-Scan Limited,
155 Adelaide Street, West,
Toronto 1, Ontario.
Attn: L.E. Richardson, President.

Trans-Canada Telephone System,
1050 Beaver Hall Hill,
Montreal, Quebec.
Attn: T.O. Carss, Assitant Vice-President (Planning) Bell Canada.

Sperry Rand Canada Limited,
Univac Division,
250 Bloor Street, East,
Toronto 5, Ontario.
Attn: E.J. Coady, Director of Marketing.

Victor Comptometer Limited,
P.O. Box 10,
Galt, Ontario.
Attn: W.H. Bell, President.

APPENDIX B

DEPARTMENT OF COMMUNICATIONS

SPECIAL REPORT

ON THE

CANADIAN REMOTE DATA-PROCESSING INDUSTRY

October 15, 1970.

Section I

Introduction

In conjunction with the Telecommission Studies an analysis of the structure of the Canadian remote data processing industry was carried out by the Department of Communications. The following report represents the results of this survey which the Department compiled during the latter half of the summer and the early fall of 1970.

The survey questionnaire was designed in order to meet two objectives:

1) To determine the size, structure and capability of the remote data processing industry in terms of equipment, manpower and finance; and
2) To evaluate the present ownership of the industry and to anticipate possible changes in ownership.

To secure such a broad range of data, the questionnaire, consisting of thirteen questions, sought information in six broad areas:

(i) hardware availability
(ii) services and marketing
(iii) rate structure
(iv) hardware ownership
(v) organizational structure
(vi) corporate expansion plans

The questionnaire was sent to twenty-two companies in the remote data processing field and replies were received from nineteen. The names and addresses of the respondents are included later in the report.

Since only a few of the companies contacted are publically-owned, it was difficult to secure complete answers to questions of a financial nature. Furthermore, the information contained in some replies was designated as confidential by the respondents. Consequently, there are certain gaps in the data presented, although, specific figures are used wherever possible. As pointed out above, not all addressees replied to the questionnaire. For this reason an accurate tabulation could not be made but it was possible to draw some relevant data from a recent study conducted by the Canadian Information Processing Society concerning the number and monetary value of computer installations in Canada. Furthermore, two of the respondents possess no hardware but do offer most software services and as such, are in competition with those offering both hardware and software; these firms are Computech Consulting, Vancouver, B.C., and A.G.T. Data Systems, Toronto, Ontario. Because of this, discussion of hardware, operating systems and communications interface will involve the replies of fourteen firms whereas, discussion of software will encompass the complete list of respondents.

It should also be noted that several Canadian universities offer time-sharing services on a commercial basis. However, these were not surveyed since the commercial activity of these schools was considered secondary to their prime function in the educational process.

This report takes the following form:

QUESTIONNAIRE CONCERNING THE CANADIAN REMOTE DATA-PROCESSING INDUSTRY

DEPARTMENT OF COMMUNICATIONS

POLICY, PLANS AND PROGRAMS

JULY 2, 1970.

1. Please describe your system facilities, i.e. central hardware, user terminals, special communications equipment, etc. listing the manufacturer, type or model, number of units and–the main memory size for each location you may have. In this regard, the following format is suggested:

LOCATION NAME

	MANUFACTURER	TYPE OR MODEL	NO. OF UNITS	MAIN MEMORY SIZE (INDICATE WORDS' BYTES' ETC.)	LINE SPEED COMMONLY USED	NO. OF LINES PRESENT MAXIMUM
C.P.U. (s)						
TERMINALS						
COMMUNICATIONS INTERFACE (i.e. IBM 2703, G.E. DATANET)						

2. Of the equipment indicated above, what is the approximate dollar value that is owned, rather than leased or rented?

3. What operating system or executive software do you use on each of the major C.P.U.'s?

Please list the major application programs you offer.

Please list the computer languages that may be used by your clients.

4. Assuming that you use data communication facilities, please indicate the following:

Supplier of Line	Type of Datasets	# of Each (both ends)

5. In addition to your own hardware facilities, as indicated in question 1, do you rent time on computers not owned, rented or leased by you?

6. Do you concentrate your marketing activities in a particular industry or industries?

If you do service specialized industries, please list these below and indicate the number of clients you serve in each.

If you offer service in a diverse group of industries, please indicate the number of clients you serve in total.

7. Please indicate the rates and rate structure for your computer services. (If the billing algorithm is complex, please attach a description)

8. What other computer related services do you offer, i.e. consulting, education, manufacturing, software package development, etc.?

9. What is the organizational structure of your firm?

How many employees do you have in total, and in each division or department. In addition, any information which you could provide us about your key technical personnel, their backgrounds, and their position within the organizational structure would be appreciated.

10. Is your company publicly or privately owned?

What are the major sources you have used to date to finance your operations, i.e. public issue, internal financing from parent organization, small group or private investors, etc.?

If it is possible to provide this, please indicate approximately what percentage of your common stock is held outside Canada.

Please attach any public financial statements for 1968 and 1969, including any prospectus that may have been issued during this period.

11. Do you plan any further financing through public issue or private placement, either debt or equity, in the twelve months starting August 1, 1970?

What sources will you likely use if you are planning additional financing?

Do you anticipate difficulty in arranging for any such financing in Canada?

12. What is the name and nationality of each member of your Board of Directors?

13. Are there any other comments you would like to make on future plans, i.e. do you have reasonably firm plans which might substantially alter any of the above information (such as announced plans for new installations or services, substantial changes in staff, changes in ownership, etc.) during the current and upcoming fiscal years?

Section III

List of Addressees

ACS - Aquila Computer Services
635 Dorchester Street West
Montreal, Quebec

AGT Management System Ltd.
74 Victoria Street
Toronto, Ontario

Aphatext Systems Ltd.
233 Gilmour Street
Ottawa, Ontario

Argus Computer Applications Ltd.
P.O. Box 5008
Victoria, B.C.

Canadian General Electric
214 King Street West
Toronto, Ontario

Computer Sharing of Canada (Com-Share)
41 Voyager Court North
Rexdale 605, Ontario

Dataline Systems Ltd.
40 St. Clair Avenue West
Toronto, Ontario

Grayhound Computer of Canada Ltd.
65 Adelaide Street East
Toronto, Ontario

Multiple Access General Computer Corp. Ltd.
885 Don Mills Road
Don Mills, Ontario

Polycom Systems Ltd.
1300 Don Mills Road
Toronto, Ontario

Symbionics Systems Ltd.
550 Berry Street
Winnipeg, Manitoba

Setak Computer Services Corp. Ltd.
20 Spadina Road
Toronto, Ontario

I.P. Sharp Associates
T-Dominion Center
Bank Tower, Toronto, Ontario

Computech Consulting Can. Ltd.
1177 West Hastings Street
Vancouver, B.C.

Computel Systems Ltd.
1200 St. Laurent Blvd.
Ottawa 7, Ontario

Computer Sciences Canada
400 Laurier Avenue West
Ottawa, Ontario

Comtech Group Ltd.
48 Yonge Street, Suite 300
Toronto 1, Ontario

Datapro London Ltd.
1925 Dundas Street
London, Ontario

Dearborn Computer of Canada
280 Ferndale Place
Kitchener, Ontario

E.D.P. Associates
2256 West 12th Avenue
Vancouver, B.C.

I.B.M. Canada Ltd.
1150 Eglington Avenue East
Don Mills 402, Ontario

Systems Dimension Ltd.
770 Brookfield Road
Ottawa, Ontario

SECTION IV

List of Respondents

A.G.T. Management System Ltd.

Alphatext Systems Ltd.

Argus Computer Applications Ltd.

Canadian General Electric Ltd.

Computech Consulting Canada Ltd.

Computel Systems Ltd.

Computer Sciences Canada Ltd.

Computer-Sharing of Canada (Com-Share)

Comtech Group Ltd.

Dataline Systems Ltd.

Datapro Limited

EDP Industries Limited

I.B.M. Canada Limited

Multiple Access General Computer Corp.

Polycom Systems Ltd.

Setak Computer Services (data is not tabulated nor included)

I.P. Sharp Associates

Symbionics Systems Ltd.

Systems Dimensions Ltd.

Section V

Analysis of Results

A. Hardware Availability

This section presents the data obtained from survey questions 1, 3(a), 4, 8, 10, 12 and 13. To simplify the discussion, the hardware availability derived from the survey has been classified as small, medium and large according to the following table:

TABLE I (includes only that hardware operated by questionnaire respondents)

MANUFACTURER	HARDWARE		
	SMALL	MEDIUM	LARGE
IBM	1460 360/20	360/40 360/50	360/65 360/67 360/85
Burroughs	B 500		B 5500
CDC			6500
Honeywell	200 125	1250	
GE	265	435	625
Univac	1005 II		1108
XDS		940	Sigma 7
DEC			PDP-10

Among those firms in the remote data processing industry who utilize central processing units of the "large" category, I.B.M. and Univac computers are the most popular choices. There are six large I.B.M. installations of which four are owned and marketed by I.B.M. itself for remote data processing services. In addition, there are four Univac 1108 computers in operation outside of the Univac firm itself; two X.D.S. Sigma Sevens; two Control Data 6500 units and one Digital Equipment P.D.P. 10 unit. Also there is a G.E. 625 in operation for remote services in Canada.

There are fewer medium size installations for remote processing service; the X.D.S. 940 and middle range I.B.M. units jointly provide the most service although there is one Honeywell middle range computer in operation.

Between them, I.B.M. and General Electric provide most small units in the marketplace. Although at the present time there are seven firms with small units and six possessing middle range equipment, the dominant trend seems to be leading towards the utilization of larger hardware. The fact that there are more small than middle-range units may be explained by the presence of several different sized units in five of our replying organizations as shown below:

	Small	Medium	Large
C.G.E.	X		X
Comshare		X	X
E.D.P.	X	X	
I.B.M.	X	X	X
S.D.L.	X		X

These figures indicate that four of the seven smaller units are balanced by the presence of medium and large units, thus substantiating the trend towards larger availability. It should be noted that all the foregoing firms show diverse marketing and large clienteles.

In all, the remote data processing industry employs a total of 39 computers of varying size; seventeen of these are owned or leased through I.B.M., five through Univac, five through Canadian General Electric and four through Honeywell. Other computers present in the remote data processing industry are manufactured by such firms as X.D.S., Digital Equipment of Canada, Control Data Corp., and Burroughs.

With the exception of S.D.L., Comshare, Symbionics and Computel, all firms offer extensive systems consulting services. Firms such as I.B.M., E.D.P. and C.G.E., also offer extensive computer related services such as education.

Without exception those firms using equipment manufactured by I.B.M., Univac, General Electric, Digital Equipment and Control Data, also utilize the manufacturer's communications interface equipment. Examples are the I.B.M. 2701 and 2703; the G.E. Datanet; the P.D.P. 680/I; the X.D.S. 7611; the C.D.C. 6600 Cybernet and the Univac CTMC. In addition, the Tymshare Canada division of E.D.P. Industries will manufacture communication interface equipment for its remote data processing cleints.

Terminal equipment shows much greater diversity than does communications interface equipment. For instance, a company such as Comshare who uses the X.D.S. Sigma 7 computer utilizes Teletype, Datapoint, Synerdata and X.D.S. terminal equipment. Similarly, Polycom who use a General Electric 435 computer also utilize a range of terminals from such manufacturers as Friden, Olivetti, Synerdata, Datapoint and General Electric. Symbionics whose central processor is the CDC 6500 use both I.B.M. and C.D.C. terminals.

As can be seen from the fact sheets in Appendix A only five companies from the list of respondents were willing to disclose plans for the upcoming months and even that information is, at best, general in nature. E.D.P. Industries have plans to expand the product lines

of their Information Services Group (ISG) involving such activities as data center, data entry, and systems and consulting. Furthermore, as mentioned below under Services and Marketing, E.D.P. will increase its multi-national posture as well as adding new divisions under ISG through acquisition and/or joint ventures into sub-markets of the computer industry. Also, Tymshare Canada Limited, division of E.D.P. Industries (TCL), is now expanding its remote data processing service into a full North American network and will manufacture certain components such as terminal equipment. They have recently opened a Toronto office for T.C.L.

S.D.L. Ottawa, will update its large IBM 360/85 with components of the new 370 line, expand marketing activities in the U.S. and Europe as well as increasing its staff. S.D.L. does not expect that it will need additional financial support for these activities.

Argus Computer Applications, Victoria, B.C. plans to grow in the time-sharing market. However, no mention was made as to whether the firm would diversify its marketing, now confined to engineering and forestry applications.

Alphatext Systems, Ottawa, plans acquisition of the remaining 50 percent of a subsidiary jointly held with a U.S. organization and further liaison with Alphatext Textran, the American firm which originated the photocomposition process used by Alphatext. This association will give Alphatext more exposure to the software innovation and product developments of the American firm.

Because of the success which Datapro Systems, London, Ontario, achieved with their Detroit office they plan more rapid growth in the American market.

B. Services and Marketing

This section of the report analyses survey questions 3(a), 3(c), and 6(a), (b), and (c). It is felt that application services are particularly related to the marketing strategies of the individual firm and to the number of clients served by that organization. Languages offered to the client are also related in the sense that languages are usually related to the nature of the problem which the program is designed to solve. For example, Fortran IV is particularly suitable for advanced business and scientific applications such as operations research.

Of the 16 respondents, only three are what can be termed as specialized in their marketing approach; A.G.T. which is not directly involved in remote data processing, Alphatext of Ottawa, and Argus Applications, Victoria, B.C.

Comshare is an example of a firm which provides a diverse offering of service applications in an attempt to gain a foothold in the Toronto market. E.D.P. Industries, located in Vancouver, have just recently opened an office in Toronto through their Tymshare Division (T.C.L.), and plan to market engineering and scientific applications; their Information Services Group, located in Vancouver, services 300 clients and the two divisions, T.C.L. and I.S.G. will service a diverse clientele.

I.B.M., Computel, C.G.E. and Computer Sciences Canada are examples of diverse marketing firms offering application services in the most lucrative service areas of business and scientific applications. I.B.M. is unique in the sense that its Remote Job Entry and Remote Job Submission Programs provide high speed terminal access to Datacenter computers in Calgary, Toronto and Montreal from every IBM Datacenter in Canada. In other words, a client may, through his terminal, gain access

to the regional Datacenter he utilizes and from there to Calgary, Toronto, and Montreal. Following the lead of I.B.M. however, E.D.P. Industries, TCL Division also have plans to form a full North American Network for remote data processing services. As noted in Section I (F), E.D.P. plans will result in substantial marketing activities in the United States. Presently, E.D.P. has offices in San Francisco and Detroit for systems and consulting services.

TABLE II

Data Returns: 3(b), 3(c), and 6(a), (b) and (c)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
A.G.T.	Mutual Fund Accounting Brokerage Accounting Payroll Educational Institution Accounting	Cobol Fortran Other	Specialized: Mutual Funds (12) Brokers (1) Educational Institutions (13) (Total Clientele - 80)
Alphatext	Remote Text Entry & Revision Computerized Type-setting & Photo-composition	Assembler Fortran R.P.G. PL/1	Specialized Marketing (Clientele is Confidential)

TABLE II (Cont' d ..)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
Canadian General Electric	Not Supplied	Cobol Fortran Basic Algol	Diverse Marketing (No. of Clients is Confidential)
Computech	Not Applicable (as explained above)	Not Applic-able	Software (10-20) Processing (2)
Computel	IBM 360/65 MPS, IMS, ICES, PCA Univac 1108 PERT-Time Cost MATH-PAC STAT-PAC ECAP-CIRCUS PCA	IBM 360/65 Fortran IV Cobol PL 2 Algol GPSS Univac 1108 Fortran V Cobol Algol GPSS Simscript 1.5	Diverse Marketing (Total Clientele-200)
Computer Sciences Canada	All Major Scien-tific & Commercial Software	Fortran Cobol Algol Basic	Diverse Marketing (Total Clientele is Confidential)
Comshare	Diverse Application are Available: PERT-Critical Path Accounting Control Text Editing On-Line Simulation Engineering Appl. Electronic Circuit Analysis Computer Assisted Education	All Languages Specially Adapted to Appl. Programs Fortran Basic Assembler QED, Edit Snobol Cobol	Diverse Marketing (60 Clients)

TABLE II (cont'd .)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
Dataline	ECAP STRESS CPM COGO Flat Plate Analysis/ Design Steel Columns Concrete Columns Bourse, Symap	Fortran IV -Interactive Fortran Cobol Basic Lisp 1.6 Aid Snobol 4	Diverse Marketing (No. of Clients is Confidential)
E.D.P.	I.S.G.-Business Applications T.C.L.-Engineering & Scientific Appl.	I.S.G. Fortran Cobol Easycoder BAL T.C.L. Super Basic Super Fortran	I.S.G.-Diverse Marketing (300 Clients) T.C.L. -Newly Formed Division (Clientele Undertermined)
I.B.M.	CALL/360 Interactive:Engineering; Mathematical, Mngt. Science Bus. Accounting DATATEXT-Text Processing Through Commands at Terminal CMS/360 Interactive-Program Develop. & Special Appl. ON-LINE SAVINGS Key-Driven Terminals at Tellers Desk-Automatic Up-Dating of Pass-books Remote Job Entry Remote Job Sub. Cross Country Net.	Basic Fortran H PL/1 Datatext Fortran G Cobol F PL/IF Assembler Cobol E, F PL/IF Assember F; Fortran G,H; Watfor, RPG	Marketing is Diverse Strategy-Marketing Specialized by Industry (Total Clientele is Confidential)

TABLE II (Cont'd ..)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
Polycom	Math & Statistics Regression Linear Programming Critical Path Engineering Graphic Bus. & Fin. Stock Analysis Educational	Fortran IV (ASC 77) Dartmouth Basic (Extended)	Diverse Marketing (Total Clientele - 150)
I.P. Sharp	Stock Exchange Analysis Accounting Statistics Actuarial Package Small Machine Simulators C.A.I.	A.P.L.	Diverse Marketing (Total Clientele - 130)
Symbionics	Hospital Info Sys Wide Range of Commercial Programs (Payroll, Receivables Inventory, etc.) Linear Programming Credit Union Process- ing Engineering Appls, Civil Electrical Structural	Fortran Cobol Algol Simscript Basic Solis (Symbionics Proprietary Language)	Diverse Marketing (Total Clientele - 150)
S.D.L.	Biomedical Business Engineering	Cobol Fortran PL 1 Assembler Algol RPG GIS Margen Simscript I Simscript II	Diverse (Total Clientele - 109 Each Govt Dept. Counts as one Client)

C. Rate Structure:

Because of the diversity inherent in rate charges for remote data processing services and because charges for these services depend upon terminal type, location, and the type of service and may be on a monthly, hourly or per unit basis, it was found impossible to standardize and present these rates in tabular form. For these reasons they are not included in the body of the report but rather appear by respondent in Appendix B.

D. Hardware Ownership:

Because this section deals with the monetary values of computer installations in Canada, much of the data obtained is classified. However, from the replies received it is possible to determine which companies own or lease computer hardware and also whether companies rent time on computers not owned, rented or leased by them thereby permitting an indication of excessive demand upon existing facilities and showing growth potential within the industry.

TABLE III

Firm	Own (Value If Available)	Lease	Rent (When Necessary)
A.G.T.	None	No	Yes
Alphatext	Yes	No	No
Argus	None	Yes	Yes
C.G.E.	Yes	No	Yes
Computech	None	None	Yes

TABLE III (Cont'd)

Firm	Own (Value If Available	Lease	Rent (When Necessary)
Computel	Yes($9.4M)	No	No
Computer Sciences	None	Yes	No
Com-Share	Yes($100,000)	Yes	Yes
Dataline	Yes($1.8M)	No	No
Datapro Ltd.	Yes($400,000)	No	No
EDP Industries	None	Yes	Rarely
IBM	Yes	No	No
Polycom	None	Yes	No
I.P. Sharp	None	Yes	No
Symbionics	Yes($3M)	No	No
SDL	Yes($11.2M)	Yes	No

According to a recent census by the Canadian Information Processing Society, the Canadian computer market grew by one-third in the year ending May 1, 1970. The Society found 2700 computers installed in Canada, 663 more than the previous year. These figures do not represent, however, growth in the remote data processing sub-market itself although they may be indicative of growth on a percentage basis. Using these figures as a basis and the figures posed in Part (a), we conclude that I.B.M. is responsible for approximately 46 percent of the total number of installed computers and that their percentage of the total dollar value fell from 70.8 percent to 66.9 percent during 1970.

Digital Equipment of Canada has made the largest gains during 1970 increasing its market share from 9.5 percent to 13.1 percent though it lags in rental value. Burroughs Business Machines Limited stands third in line, Honeywell and General Electric place fourth and fifth.

These figures do not however agree with those derived in this survey where I.B.M., Univac and Digital Equipment were, in that order, the largest suppliers to the remote data processing industry.

E. Organizational Structure

One of the most important questions and yet probably the most difficult to discuss and summarize is that dealing with organization structure and key personnel. The following table indicates, where data is not confidential, the number of employees presently engaged by each organization.

TABLE IV

Firm	Number of Employees
A.G.T.	259
Alphatex	51
Argus	5 full time; 5 part time
C.G.E.	20,000 total; Number of employees in remote processing-not available.
Computech	17
Computel	Not available
Computer Sciences	Not available
Comshare	Not available
Dataline	40
Datapro	67
EDP Industries	300
I.B.M.	9,300 (4,100 in Toronto)
Polycom	Not available
I.P. Sharp	60
Symbionics	88
S.D.L.	101

With the exception of the smaller firms who specialize basically in single marketing activities, most firms organize according to sub-markets of the computer industry. For instance, Computel is organized into separate branches with each branch having both an operational and marketing division.

In addition, Computel has a Research and Development Branch to carry out development in software, applications and technical consulting. Similarly, C.G.E. is a diverse organization functionally delineated along product lines. A smaller firm, Dataline, is organized into divisions along the following lines; marketing, operations, programming, support and administration. Because of the relatively small size of these firms, they would face less communication difficulty than would a firm such as C.G.E. Thus marketing, programming and operations can be usefully separated rather than combined as in Computel. EDP Industries is a further example of an organization designed for the marketing function. The Information Systems Group and Tymshare Canada Ltd. aim at specific sub-markets.

This approach to marketing and organizational structure seems to be the predominant approach among most firms. It is simply organizing to meet the needs of the marketplace. As Part F of this Section will show corporate expansion plans indeed reflect sensitivities of the market.

F. Corporate Expansion Plans

This section discusses the results from survey question eleven indicating those firms anticipating financial needs in the year August 1, 1970 - July 31, 1971. Again, because of the confidential nature of this material, some firms have requested that their plans remain disclosed. Table V, though, represents the results within the limitations of the above constraint.

TABLE V

Firm	Financing 1970-71	Source
A.G.T.	Yes	Private Placement
Alphatext	Yes	Private Equity Placement
Argus	Probably	Private Investors
C.G.E.	No	Not Applicable
Computech	Probably No	Debt Or Equity
Computel	No	Not Applicable
Computer Sciences	No Comment	No Comment
Comshare	No	Not Applicable
Data Line	No Comment	No Comment
Data Pro	No	Not Applicable
E.D.P.	No	Not Applicable
I.B.M.	As Required	Institutional Investors or Public Issue
Polycom	Yes	Private Investors
I.P. Sharp	No	Not Applicable
Symbionics	No Comment	No Comment
S.O.L.	No	Not Applicable

From the replies, it can be seen that four companies are definitely anticipating financial requirements in 1971; A.G.T. Alphatext, Argus and Polycom Systems. Of these firms Argus Applications, a small, specialized and private firm, anticipates little difficulty in locating financial sources, whereas Alphatext, also private, states they have always had difficulty in locating financial sources. Attractive market conditions and the possibility of favourable sales may play a role since Argus is functionally specialized towards forestry and engineering in Victoria, B.C. where the need could be high and competition minimal. Alphatext, on the other hand, lies in the more competitive market of Ottawa and must contend with diverse marketing firms offering similar services. However, both A.G.T. and Polycom are public companies who feel they will face little difficulty in locating financial sources. It should be noted that Polycom is a closely held public company whose financial sources could be generated from within.

Both Computech and E.D.P. Industries, the former private and the latter public, find difficulty in obtaining financial support. They believe, significantly, that it is the nature of the industry itself and the low risk posture of the Canadian Investor which hinder efforts in locating financial sources. These thoughts are not uncommon in Canadian financial markets.

Investment success may depend upon the nature of the individual firm, its market, the size of the firm as well as the industry itself and the risk posture of Canadians. The more specialized

market-oriented firm such as Argus & Datapro experience little difficulty whereas the larger public firms in diverse markets face more difficulty such as that experienced by E.D.P. More discussion of this matter will be found in Section V: The State of the Industry.

Section VI

The State of the Remote Data Processing Industry

On the basis of the information presented in the preceeding sections, a summary picture of the industry can be drawn:

The remote data processing industry, involving interactive time-sharing and remote batch processing, has evolved rapidly since 1968 with the advent of numerous small and medium sized independent companies. In addition, new companies were created to sell the specialized application services associated with remote processing. However, through the latter part of 1969 and continuing in 1970, the industry experienced a period of re-adjustment brought about by an over-optimistic assessment of the potential for market growth and by the general economic slowdown. Because of these conditions, the replies from the questionnaire reflect present financial and market conditions of industry members and must be considered in any analysis of the structure of the industry.

A major trend seems to be the growing proliferation of diverse marketing organizations in the remote data processing sector of the industry. They are considered diverse in marketing because of the wide number of applications they offer to their clients. This trend is particularly evident in Ontario which, until 1970, showed the fastest rate of growth in computer hardware installation. Because of this trend to diverse marketing, a number of the smaller firms have faced apparent financial difficulties and indeed several have been purchased by U.S. owned corporations (i.e. Aquila Computing Services and Central Data

Processors). In the past, smaller firms who have specialized in filling a particular sub-market need have enjoyed some measure of success. However, since the growth of the more diverse firm now seems to be the dominant factor, this specialization may well become a constraint. In other words, the firm offering more services is apt to get the business. Further, because of the previously mentioned financial conditions, it would be increasingly difficult for the smaller firm to enter and compete with these diverse marketing organizations.

It is difficult to conclude that this industry as a whole has faced serious difficulty in securing funds. From the survey results, a mixed picture emerges. The wholly owned subsidiaries of foreign corporations are diverse and large enough to generate funds from within or from their parent organizations while the independent Canadian firms encounter a different kind of problem. One of the most frequent comments was that the industry faced difficulty securing funds because of the nature of the industry and market itself and because of the low risk posture of Canadian investors. The most significant variable could well be the closeness of the organization, public or private, to the investment community and its access to institutional investors. The fact that institutional investors may have more control over financial markets than in most other countries may, through market behaviour, influence the unavailability of speculative funds from individual investors. This is the classic problem of thin markets where institutional investors are able to control the "ups and downs". Relative to the United States, there is a lack of venture capital in Canada to supply needed liquidity

to some of the higher risk equity issues common to the independent remote data processing industry.

Concurrent with the trend towards diverse marketing applications is the trend towards the "big computer" necessary to provide simultaneous access from many remote terminals. Circumstances surrounding current financial market performance compound the difficulties, already spoken of, for independent organizations entering a market showing the above trend.

Because of the relative scarcity of investment money and the trend to "bigness" it is likely that rationalization will occur in the industry in the foreseeable future. The capital intensive nature of the industry, the extensive capital resources required to underwrite research and development and to market the resultant products, and the lack of venture capital places a premium on corporate size. In addition, the development of new applications is dependent upon the acquisition of new hardware systems, and major operating systems, as they become larger and more generalized, will require larger and larger amounts of capital for their development. Therefore, the pattern of market growth could be one of rationalization into a relatively small number of large firms, each able to provide customers with a multiplicity of products and services by means of a nation-wide network of data centers.

As mentioned above, the small specialized firm will face immense difficulty in an industry showing these trends. The lack of venture capital will force future development to the large corporation. This fear was expressed by many of the respondents and seems to be a realistic appraisal of the current remote data processing industry situation.

APPENDIX A

RESPONDENT FACT SHEETS

NAME: A.G.T. SYSTEMS LTD.

ADDRESS: 74 Victoria St.
Toronto 210, Ont.
Canada.

SERVICES OFFERED: Consulting - Remote Data Processing
Education
Manufacturing
Software Package Development
Marketing Responsibilities for some U.S. and Canadian Firms

LOCATION AND SIZE OF COMPUTERS:

a) Manufacturer - Type or Model: Not applicable

No. of Units

Main Memory Size

Operating System

b) Terminals — Line Speed Used

N/A

c) Communications Interface: N/A

d) Data Communications Facilities: N/A

Plans: No Comment

BOARD OF DIRECTORS:

H.S. Gellman - Canadian
H. Lerchs - Canadian
D.R. McCamus - Canadian
G.H. Montague - Canadian
L.W. Shick - Canadian
G.A. Wanless - Canadian
F.T. White - Canadian

CAPITALIZATION:

Long-term debt $4,000
2,000,000 common shares authorized with no par value
1,118,520 issued with a value of 2,780,168

Ownership - very small percentage of common stock held outside Canada

AFFILIATION: None

NAME: ALPHATEXT SYSTEMS LTD.

ADDRESS: 233 Gilmour St.
Ottawa, Ont.
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Specialized Software Package Development

LOCATION AND SIZE OF COMPUTERS: Ottawa

a) Manufacturer - Type or Model: I.B.M. 2040

No. of Units: 1

Main Memory Size: 128,000 Bytes

Operating System: I.B.M. Disk Operating System

b) Terminals:

	Type	No. of Units	Line Speed Used
I.B.M.	2741	50	135 baud
U.C.C.	DATEL 30	10	135 baud

c) Communications Interface

Communications Interface	No. of Units	No. of Lines
I.B.M. 2703	1	176

d) Data Communications Facilities

Data Communications Facilities	Type	No. of Each (both ends)
Bell Canada	103A	80

Plans:

Purchase Remaining 50% of a 50% held subsidiary investment. Closer relationship with original developers of Alphatext Photocomp. for software development and innovation.

BOARD OF DIRECTORS:

M. Aronovitch - Canadian
J. Bobak - Canadian
G.A. McInnes - Canadian
A. deLobe Panet - Canadian
G. Perley-Robertson - Canadian
S. Sokoloff - Canadian
E. Goodwin - Canadian

CAPITALIZATION:

Privately Owned and Financed
Private Equity Placement

Ownership - 100 percent held in Canada

AFFILIATION: None

NAME: ARGUS COMPUTER APPLICATIONS LTD.

ADDRESS: 222 - 727 Johnson St.
P.O. Box 5008
Victoria, B.C.
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Software Package
Systems Design
Feasibility Studies
Programming

LOCATION AND SIZE OF COMPUTERS: Victoria, B.C.

a) Manufacturer - Type or Model: Univac 1005 III

No. of Units: 1

Main Memory Size: 4K Characters

Operating System: Univac Exec II and Exec VIII

b) Terminals	Model	Line Speed Used
		4800 HZ (not yet installed)

c) Communications Interface: Not yet installed

d) Data Communications Facilities	Type	# of Each (both ends)
TCTS	301A	2

Plans: Time sharing being planned

BOARD OF DIRECTORS:

D.H. Peacock - Canadian
J.A. Carmichael - Canadian
T.J. Halbert - Canadian

CAPITALIZATION:

Private company - private finance sources

Ownership - 100% Canadian held

AFFILIATION: None

NAME: CANADIAN GENERAL ELECTRIC CO. LTD.

ADDRESS: 214 King St. W.
Toronto 129, Ont.
Canada.

SERVICES OFFERED:
- Remote Data Processing
- Systems Consulting
- Systems Design
- Program Development
- Batch Processing
- Computer Education

LOCATION AND SIZE OF COMPUTERS: Toronto

a) Manufacturer - Type or Model:	G.E.-265	G.E.-625
No. of Units:	3	1
Main Memory Size:	16K Words	128K Words
Operating System:	G.E. MARK 1 EXEC	G.E. GECOS III EXEC

b) Terminals	Model	Line Speed Used
General Electric	TN-300	
General Electric	GE-115	110 baud
Teletype Corp.	ASR-33	
Teletype Corp.	ASR-55	

c) Communications Interface		No. of Lines
General Electric - DN-30	GE-265	240
	GE-625	40

d) Data Communications Facilities : Confidential

Plans: Confidential

BOARD OF DIRECTORS:

J.A. Beland	- Canadian	R.H. Jones	- American
W.R.C. Blundell	- Canadian	W.F. McLean	- Canadian
R.V. Corning	- American	M. McMurray	- Canadian
P. Desruisseax Q.C.	- Canadian	M.C.G. Meishen	- Canadian
O.L. Dunn	- American	H.B. Miller	- American
H.W. Gouldthorpe	- American	J.H. Smith	- Canadian
H.M. Griffith	- Canadian	W.G. Ward	- Canadian
W.C. Harris	- Canadian		

Capitalization:

Publicly Owned
Financing generated internally

Ownership - 95% held outside Canada

AFFILIATION: General Electric U.S.

NAME: COMPUTECH CONSULTING CANADA LTD.

ADDRESS: 1404-1177 West Hastings St.
Vancouver 1, B.C.
Canada

SERVICES OFFERED: Consulting
Systems Analysis, Design, Programming
Temporary and Permanent Installation Management
Education
(No Direct Remote Service, although Consult on this)

LOCATION AND SIZE OF COMPUTERS: Not Applicable

a) Manufacturer - Type or Model

No. of Units:

Main Memory Size:

Operating System:

b) Terminals Line Speed Used

c) Communications Interface:

d) Data Communications Facilities

Plans: No Comment

BOARD OF DIRECTORS:

J.A. Speight - Canadian	G.R. Long - Canadian
W.E.S. Tennant - Canadian	G.R. Gisel - Canadian
R.I. Field - Canadian	I.V. Reid - Canadian

CAPITALIZATION:

Private - Financing by Cash Flow

Ownership - 100 per cent Canadian held

AFFILIATION: None

NAME: COMPUTEL SYSTEMS LTD.

ADDRESS: 1200 St. Laurent Blvd.
Ottawa 7, Ont.
Canada.

SERVICES OFFERED: Remote Data Processing
Limited Consulting
Education
Software Package Development

LOCATION AND SIZE OF COMPUTERS:

	OTTAWA		TORONTO
a) Manufacturer - Type or Model:	IBM 360/65	UNIVAC 1108	UNIVAC 1108
No. of Units	1	1	1
Main Memory Size	512K Bytes	64K Words (36 bit)	131K Words (36 bit)
Operating System	MFT II + HASP 2.3 MVT + HASP 2.0	EXEC II EXEC VIII	EXEC II EXEC VIII

b) Terminals	No. of Units	Line Speed Used
IBM 1130	14	
MOD 20	1	4800 baud
UNIVAC 9200	3	
9300	3	
1004	3	

c) Communications Interface	Type	No. of Lines	No. of Units
IBM	2701	2	3
UNIVAC	CTS		6
NOVA		6	4

d) Data Communications Facilities	Type	# of Each (both ends)
Bell	Rixon 48-C	20
	201B	9
CN-CP	Rixon 48-C	27

Plans: No comment

BOARD OF DIRECTORS:

R.T. Horwood	- Canadian	R.N. Steiner	- Canadian
F.B. Brooks-Hill	- Canadian	A.M. Wyszkowski	- Canadian
G.R. Cogar	- American	R.T. Lane	- Canadian
C.G. Fleming	- Canadian	R.C. Heilig	- Canadian
C.E. O'Connor	- Canadian		

CAPITALIZATION:

Financing through public issue and private placement

1,000,000 common shares without par value authorized

581,142 issued at a total value of 4,229,997

Total long term debt - 5,964,000

Ownership - 10-15 per cent is held outside Canada.

AFFILIATION: None

NAME: COMPUTER SCIENCES CANADA, LTD.

ADDRESS: 1470 Don Mills Rd.
Don Mills, Ontario
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Systems Development
Education
Software Package Sales Basic, DRJE, RJE

LOCATION AND SIZE OF COMPUTERS: Calgary and Toronto

a) Manufacturer - Type or Model: UNIVAC 1108

No. of Units: 2

Main Memory Size: Calgary - 131K Words
Toronto - 196K Words

Operating System: Calgary - EXEC. II
Toronto - CSCX

b) Terminals | Line Speed Used

Confidential

c) Communications Interface | Type

Calgary - UNIVAC	CTMC/CTM
Toronto - UNIVAC	CTML/CTM

d) Data Communications Facilities: Confidential

Plans: No Comment

BOARD OF DIRECTORS: Confidential

CAPITALIZATION:

Private Company
Financed Internally

Ownership - 49% held in U.S. (C.S.C.)

AFFILIATION: 51 per cent CN-CP
Computer Sciences, U.S.
CN/CP Telecommunications

NAME: COMSHARE (CANADA) LIMITED

ADDRESS: 41 Voyager Court North
Rexdale 605, Ont.

SERVICES OFFERED: Remote Data Processing Service Applications

LOCATION AND SIZE OF COMPUTERS: Toronto, Ont.

a) Manufacturer - Type or Model: XDS SIGMA 7

No. of Units: 1

Main Memory Size: 320K Bytes

Operating System: COMSHARE MODIFIED XDS BTM

b)

Terminals	Model	Line Speed Used
TELETYPE	33,35	110 baud or 300 baud
DATAPOINT	3300	110 baud or 300 baud
SYNERDATA	BETA	110 baud or 300 baud
XDS	7670	2400 baud

c)

Communications Interface	No. of Lines Present	No. of Lines Maximum
XDS - 7611	64	

d)

Data Communications Facilities	Type	No. of Each (both ends)
Bell	103A2	50
	201B	10

Plans: Not Available

BOARD OF DIRECTORS:

A.D. Waren - Canadian
L. Sacks - American
J.G. Debanne - Canadian
R.F. Guise, Jr. - American
R. Crandall - American
R.S. Willoushby - Canadian
G. Lewis - Canadian
E.V. Hibberd - Canadian
W.S. Dyke - Canadian
R.E. Hatch - Canadian
B. Bracewell - Canadian

CAPITALIZATION:

Privately Owned - Not Available

Ownership - 30 per cent held outside of Canada

AFFILIATION: Computer Sharing Corp., U.S.A.

NAME: DATALINE SYSTEMS LIMITED

ADDRESS: 40 St. Clair Ave. W.
Toronto, Ontario
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Programming
Education
Dedicated System
Turnkey Management

LOCATION AND SIZE OF COMPUTERS: Toronto

a) Manufacturer - Type or Model: Digital Equipment of Canada Ltd.
PDP 10 Model 50

No. of Units: 1

Main Memory Size: 128K Words, 640K Bytes

Operating System: DSL Swapping Monitor Level 50

b)

Terminals	Type	Line Speed Used
Teletype	33, 35, 37	110 baud
Syner Data	BETA	300 baud
Texas Instrument	TI-200	110"300 baud
I.B.M.	2741	134.8 baud

c)

Communications Interface:	Type	# of Lines
Digital Equipment	680/I	127

d)

Data Communications Facilities	Type
Bell Canada	103F
CN/CP	201
	Data-Telex

Plans: None

BOARD OF DIRECTORS:

J.F. Galipeau - Canadian
J.C. Paraoi - Canadian
E.S. Lee - Canadian
J.A. Wright - Canadian
G.S. Dembroski - Canadian

CAPITALIZATION:

1,000,000 authorized common stock without par value
400,000 issued with a value of 2,722,480

Ownership - 100 percent held in Canada

AFFILIATION: None

NAME: DATAPRO LIMITED

ADDRESS: Corporate House
376 Richmond St.
London, Ont.
Canada

SERVICES OFFERED: Off-Line Data Processing
Keypunching
Keyverifying
Customized Programming
Consulting

LOCATION AND SIZE OF COMPUTERS: London, Ont.

a) Manufacturer - Type or Model: Burroughs B500

No. of Units: 1

Main Memory Size: 19.2K Characters

Operating System: M.C.P. II Rev. 4

b)

Terminals	No. of Units	Line Speed Used
N.C.R. Encoder	2	2000 bits per second

c) Communications Interface: No Comment

d)

Data Communications Facilities	Type	No. of Each (both ends)
Bell Canada	201A	

Plans:

Further expansion into U.S. due to success of Detroit office.

BOARD OF DIRECTORS

N.C. More - British
B.J. Bentley - British
F.G. Berlet - British

A. More - British
C. Demeyere, Jr. - British
E. Demeyere - British
G. Demeyere - British

CAPITALIZATION:

1,000,000 common shares authorized without par value
450,006 issued at a value of 781,000

Ownership - Less than 1 percent held outside Canada

AFFILIATION: None

NAME: EDP INDUSTRIES LIMITED

ADDRESS: 401 - 1111 West Hastings St.
Vancouver 1, B.C.
Canada

SERVICES OFFERED:

Information Systems Group (ISG) - Data Center Services including Accounting Service
Systems and Consulting
Data Entry - All collection and entry services
Tymshare Canada Limited (TCL) - Interaction Timesharing
Dimension Personnel - personnel selection and placement
Pacific Leasing Corp. - 3rd party leasing

LOCATION AND SIZE OF COMPUTERS: Vancouver

	ISG			TCL	
a) Manufacturer - Type or Model:	Honeywell 200	125	1250	XDS 940	SIGMA 7
No. of Units:	2	1	1	varies by month	
Main Memory Size:	32K	32K	49K	varying	

Operating System:

ISG - MOD I and MOD I Extended
TCL - Execution Software developed by Tymshare

b) Terminals	Type	Line Speed Used
TCL Teletype	ASR 33 35	Not yet installed

c) Communications Interface:

TCL - Self Manufactured

d) Data Communications Facilities:

TCL - Bell Canada - Not yet installed

Plans:

Expand ISG product lines - Data Center, Data Entry & Consulting
Increase Multi-National Posture
Expand Divisional Entries of ISG - Acquisitions & Joint Ventures

BOARD OF DIRECTORS:

W.R. Wood - Canadian
A.M. Eyre - Canadian
B.J. Kaganov - American
D. Fulton - Canadian

D.H. McVeigh - American (in Canada since 1952)
I.M. Wolfe - American (in Canada since 1965)

CAPITALIZATION:

Public company
Long-term debt - 1,589,000
Preferred shares - 100,000 5% cumulative at $25 par - issued 2,323,000
Common shares - 1,000,000 authorized - no par value - issued 1,753,000

Ownership - less than 1 percent held outside Canada

AFFILIATION: None

NAME: I.B.M. CANADA LTD.

ADDRESS: 1150 Eglington Ave. E.
Don Mills 402, Ont.
Canada

SERVICES OFFERED: Remote Data Processing
Manufacturing of Data Processing and Office Products
Maintenance of Products
Systems Consulting
Custom Contract Services
Program Products
Education

LOCATION AND SIZE OF COMPUTERS: Calgary, Montreal, Toronto, Ottawa

a) Manufacturer - Type or Model: Confidential

No. of Units:

Main Memory Size:

Operating Systems:

b) Terminals: Confidential Line Speed Used

c) Communications Interface: Confidential

d) Data Communications Facilities: Confidential

Plans: Not Available

BOARD OF DIRECTORS

T.J. Bata - Canadian	G.E. Hall - Canadian	R.H. Thomas - Canadian
H. Borden - Canadian	G.E. Jones - American	T.J. Watson - American
J.E. Brent - Canadian	A.T. Lambert - Canadian	S.M. Wedd - Canadian
M. Faribault - Canadian	L.K. Lodge - Canadian	(Honorary Director)
	W.V. Moore - Canadian	

CAPITALIZATION:

Wholly Owned Subsidiary of I.B.M. World Trade Corp.
Private Financing - Canadian Banks and Insurance Companies

Ownership - 100 per cent held outside Canada

AFFILIATION: I.B.M. World Trade Corp.

NAME: I.P. SHARP ASSOCIATES

ADDRESS: Toronto-Dominion Center
Toronto 1, Ontario
Canada.

SERVICES OFFERED: Consulting
Education
Hardware Design and Manufacture
Proprietary Software

LOCATION AND SIZE OF COMPUTERS: Toronto

a) Manufacturer - Type or Model: I.B.M. 360/50

No. of Units: 1

Main Memory Size: 384 K

Operating System: D.O.S. Modified

b)

Terminals	Type	Line Speed Used
I.B.M.	2703 1050	134.5
Datel		
Dura		

c)

Communications Interface	No. of Lines
I.B.M. 2703	88

d)

Data Communications Facilities	Type	No.of Each (both ends)
Bell Canada	103A2	176
AT & T	TC1000 Multiplexor	1 per 28 lines

Plans:

No comment.

BOARD OF DIRECTORS:

I.P. Sharp - British	D. Smith - Canadian
R.D. Moore - American	E.A. McDorman - Canadian
R. Murray - Canadian	

CAPITALIZATION

Private company - financed out of profits and small group of institutional investors

Ownership - 100 per cent in Canada

AFFILIATION: None

NAME: POLYCOM SYSTEMS LIMITED

ADDRESS: 1300 Don Mills Rd.
Toronto, Canada

SERVICES OFFERED: All Services Except Manufacturing

LOCATION AND SIZE OF COMPUTERS: Toronto, Ont.

a) Manufacturer - Type or Model: General Electric 435

No. of Units: 1

Main Memory Size: 64K Words

Operating System: MODIFIED SOFTWARE G.E. 400 SERIES, TIME-SHARING

b)

Terminals	Model	Line Speed Used
TELETYPE		
FRIEDEN		110 baud
G.E.	ASC	
OLIVETT		
SYNERDATA		
DATAPOINT	3300	

c)

Communications Interface	No. of Lines Present	No. of Lines Maximum
G.E. DATANET 30	30	60

d)

Data Communications Facilities	Type	# of Each (both ends)
Bell Canada	103A	150

Plans: Not Available

BOARD OF DIRECTORS:

D.C. Webster - Canadian
J.P. Humfrey - Canadian
F.B. Rich - Canadian
R.L. Shirriff - Canadian
M.J. McCabe - Canadian
G.J. Risby - British

CAPITALIZATION:

Invested Capital Raised Privately - Closely Held Public Company

Ownership - 98.6 percent of Common Stock is held in Canada

AFFILIATION: None

NAME: SYMBIONICS SYSTEMS LIMITED

ADDRESS: 550 Berry St.
Winnipeg 21, Manitoba
Canada.

SERVICES OFFERED: Remote Data Processing
Programming
Facilities Management

LOCATION AND SIZE OF COMPUTERS: Winnipeg

a) Manufacturer - Type or Model: Control Data 6500

No. of Units: 1

Main Memory Size: 65K Words

Operating System: CDC Scope

b) Terminals

Terminals	Line Speed Used
Control Data 200 UT	2000 baud
I.B.M. 1130	-

c) Communications Interface

CDC Cybernet 6600

d) Data Communications Facilities

Data Communications Facilities	Type	# of Each (both ends)
Western Electric - Sangamo	201A	8
Western Electric	103A	5

Plans: No comment

BOARD OF DIRECTORS:

M.C. Holden - Canadian
B.A. Hodson - Canadian
D.R. Sprague - American
E.E. Erhart - Canadian
J.C. McKinnon - Canadian
R. Friend - Canadian
D. Steele - Canadian

CAPITALIZATION:

Public Company
D.E. Ratio not available through questionnaire

Ownership - 2 per cent held outside Canada

AFFILIATION: None

NAME: SYSTEMS DIMENSIONS LIMITED

ADDRESS: 770 Brookfield Road
Ottawa 8, Ont.
Canada

SERVICES OFFERED: Remote Data Processing
Manufacturing - SDL Model T101 high resolution timer
Education - Seminars, Workshops,
Software Package Development

LOCATION AND SIZE OF COMPUTERS:

	Ottawa	Toronto/Montreal/London
a) Manufacturer - Type or Model	I.B.M. 360/85	I.B.M. 360/20
No. of Units	1	3
Main Memory Size	2,000,000 Bytes	8K Bytes
Operating System	O/S HASP MVT	

b) Terminals	Type	No. of Units	Line Speed Used
I.B.M.	2741	27	150 baud
	2780	7	2400 baud
REMCOM	2780	3	4800 baud
DATA	100	2	(New York & Boston - 2000 baud)

c) Communications Interface	No. of Units	No. of Lines Present	No. of Lines Maximum
I.B.M. 2703	2	14	28
I.B.M. 2701	1	16	32

d) Data Communications Facilities			No. of Each (both ends)
Bell Canada	201 B3		9
	201 A3		12
	103 A2		27
	48 C		6
CN/CP	Rixon	4800 baud	2
	Milgo	4800 baud	6
	Lenkurt	26 C	4

Plans:

1. Expand Model 85 with system 370 components
2. Expand marketing in U.S.
3. Market software application, accountpak, in Europe
4. Expand Staff

No additional financing or change in ownership is anticipated

BOARD OF DIRECTORS:

G.A. Fierheller	- Canadian	P. deG. Beaubien	- Canadian
G.M. Morton	- British	J.W. Graham	- Canadian
J.M. Russell	- Canadian	J.R. Lemesurier	- Canadian
R.C. Quain, Jr.	- Canadian	J.M. Tory	- Canadian
		W.S. McCarthy	- Canadian

CAPITALIZATION:

Publicly Owned
3,000,000 Authorized
1,311,240 Issued - Public Underwriting - Feb. 1969 - $17,500,000
Private Placement - May 1970 - $1,500,000
Long-Term Debt - $9,947,000

Ownership - 99.08 per cent held in Canada by 2715 Stockholders

AFFILIATION: None

Rate Structures

A.G.T. Data Systems Limited -

Rates are not applicable because no computer is installed on their behalf. Charges are based upon service bureaus utilized.

Alphatext Systems Ltd. -

(See copy of Schedule of rates)

Argus Computer Applications Limited -

Pricing is, at time of survey, under review and new prices are unavailable.

Canadian General Electric -

Mark I Service: $12.00/terminal hour, .06 per central processor unit; $2.50 per 1500 character storage.

Mark II Service: $9.00 per terminal hour; .60 per 1000 input-out characters; .50 per central processor unit; $1.10 per 1200 characters storage.

Computech Consulting Limited -

Machine time is billed directly to the client by the service bureau used. Charges are based on hourly usage and vary from $125.00 per hour for a 196K Model 40 to $35 per hour for a 1460.

Computel Systems Limited -

(See copy of Schedule of rates)

Computer Sciences Canada Limited -

Calgary: $1200/C.P.U. hour (top priority)
$ 800/C.P.U. hour (2nd priority)
$ 600/C.P.U. hour (3rd priority)

Toronto: Basic - $.60/C.P.U. second
- $11.00/hour connect

File Storage - $1.50/page/month
(Page - 3,072 characters)

RJE & OTC: - 1st priority \$850/C.P.U. hour
2nd priority \$650/C.P.U. hour

File Storage - \$.075/track/day
(Track = 10,752 character)

Comshare -

No figures are provided

Datapro -

Confidential: based on usage of equipment plus some minimum charges, based on per hour use.

Dataline -

(See copy of Schedule of Rates)

EDP Industries Limited -

Rates are competitive

I.B.M. Canada Limited -

Rates are based on the remote data processing service offered. The following are the application services offered by I.B.M. (description of these are found in the body of the report).

CALL/360 - \$8.00 per hour connect
\$13.80 per minute C.P.U.
\$1.30 per 3440 bytes storage
Minimum \$100 per month

CMS/360 - \$10.00 per hour connect
\$24.00 per minute C.P.U.
\$21.00 per 120,000 bytes of storage
Minimum \$100 per month

Datatext - Basic charge \$540 per month

On-Line-Savings - \$.75 per account per year
\$.40 per loan per year for processing storage, additional charges for conversion, line appearances and non-financial file changes.

Remote Job Entry
Remote Job Submission - Hourly rates based on system configuration.

Polycom Systems Limited - rates as of April 10, 1970.

A. Commercial Rates for Time-Sharing

(1) Terminal Connect Time:

Daytime (8:00a.m. - 6:00p.m.) Monday-Friday	$10/hr
Other than hours above	$ 7/hr

(2) Central Processing Units:

Daytime (8:00a.m. - 6:00p.m.) Monday-Friday	$.05/unit
Other than hours above	$.03/unit

(3) Disc Storage:

Monthly based on the average level of storage with a minimum file size of only 100 characters. This keeps storage overheads extremely low.

$.10/100 characters

B. Educational Rates for Time-Sharing

(1) Terminal Connect Time:

Daytime (9:00a.m. - 5:00p.m.) Monday-Friday	$10/hr
Other than hours above	$ 7/hr

(2) Central Processing Units:

Daytime (9:00a.m. - 5:00p.m.) Monday-Friday	$.05/unit
Other than hours above	Nil

(3) Disc Storage $.10/100 characters

C. Additional Service Rates

Off-Line Printing: $2.50 for each 20 pages
Off-Line Card Reading: $2.50 for each 1000 cards
Off-Line Card Punching: $2.50 for each 500 cards
Off-Line Storage: Minimum monghtly charge of $500 plus
.01 per 100 characters (loaded or unloaded)

The above charges have a $2.50 minimum for each request.

Tape Boxes: $1500 per 100 boxes
Manuals: $.25 each

Systems Dimensions Limited -

(See copy of Schedule of Rates)

I.P. Sharp Associates -

$10.00 per connect hour
$13.00 per C.P.U. second
$10.00 per month per 32 k storage

Symbionics Systems Limited -

Standard rate and service - $.195/system second
- surcharge for express service and discount for 2nd shift and volume.

Input/Output - 1.45/1000 lines printed
1.00/1000 cards read

(system second accounts for C.P.U. time, peripheral processor time, central memory and priority)

```
i.e. System Second =  .89 C.P. + .150 P.P. + .0079
                     (CP + PP) (CM)   PR
```

alphatext

Schedule 'A'

Charges for Alphatext's service will be in accordance with the following schedule:

1. Monthly Rental of the Typewriter Terminal $123.50

2. One time installation charge $100.00

   This includes the delivery and installation of a terminal and a communications line with the necessary typewriter connection.

3. Dedicated Access assures availability of connection of the typewriter terminal to the Textcentre computer at all times during each session the computer system is operational.

4. A communications line with the necessary typewriter connection is included in the Minimum Monthly Charge of each of Plan B.1. and B.2.

5. Basic Monthly Contract Options:

	Plan B.1.	Plan B.2.
Minimum Monthly Charge	$300.00	$550.00
Access	Dedicated	Dedicated
Positions of Permanent Computer Storage	Up to 100,000	Up to 200,000
Monday to Friday Availability	Either 8:00 a.m. to 1:00 p.m. or 1:00 p.m. to 6:00 p.m.	8:00 a.m. to 6:00 p.m.

6. Overtime usage is available upon request from 6:00 p.m. to 9:00 p.m. Monday to Friday and 9:00 a.m. to 1:00 p.m. Saturday.

   First connect hour of overtime usage in a calendar month $25.00

   Each additional connect hour of overtime usage $4.00

7. Monthly charge for each additional Permanent Storage Record (PSR) $0.30

   (1 P.S.R. = 1550 positions)

   Note:

   A position of permanent computer storage is defined as one keystroke. A keystroke constitutes the depression of any key on the typewriter terminal, including the space bar, tab and backspace.

   The actual number of positions of direct access computer storage used will depend upon the efficiency of the operator, the format of the text and upon the document length.

   Charges for additional permanent storage will be based on the average of the excess daily usages for the month.

8. Archive storage documents may be read from or written onto on-line magnetic tape units at any time in the Textcentre.

   Charges: Per document written onto Archive Tape $0.10
   Per document retrieved from Archive Tape $0.25

alphatext

9. Charges per 1000 lines printed in the Textcentre by the high speed printer:

Line Spacing	Nylon Ribbon	Mylar Polyester Ribbon
Single	$2.75	$3.25
Double	$3.00	$3.50

The standard type style on the high speed printer in the Textcentre is a Courier font with a range of 126 characters including upper and lower case alphabetics, special symbols, and French diacritical marks.

10. Charges for continuous form paper are additional:

Paper Description	Charge Per Sheet	Set Up Charge
15 x 11 one-part white bond (32M)	$0.010	NC
8½x 11 one-part white bond (40M)	$0.015	NC
15 x 11 two-part	$0.030	$1.00
5 x 11 three-part	$0.050	$1.00
15 x 11 four-part	$0.070	$1.00
15 x five-part	$0.090	$1.00
Customer supplied forms	NC	$2.00

11. Charge per delivery $1.00

12. Forms handling charge:

Decollating and bursting per hour $8.00

Alphatext Systems Limited

The Alphatext Photocomposition Price Schedule

Agreement Number:

Schedule 'B'

Composition and photoprinting from IBM System/360 Magnetic Tape containing the text to be set and the applicable composition codes. Charges for Alphatext's Photocomposition Service will be in accordance with the following schedule:

1. Textran

(a)	Composition per 1000 characters		$ 1.00
(b)	Pagination per column line		0.01
(c)	Media per foot -	Paper positives	0.50
		Film positives	1.75

2. Tape to Type

(a)	Composition per 8½ x 11 page	$ 6.00

3. Customer Service Representative

Customer service analyst for composition set-up and coding per hour	$15.00

October 6, 1970

computel

COMPUTEL SYSTEMS LTD.,
1200 St. Laurent Boulevard,
Ottawa 7, Ontario.

SCHEDULE OF COMPUTING SERVICES RATES

SCHEDULE A

	DEDICATED TERMINAL AND COMPUTING SERVICES COMMITMENT AGREEMENT	COMPUTING SERVICES AGREEMENT	PER
A. UNIVAC 1108			
1. CPU			
Prime	$750.00	$800.00	CPU hour
Demand	600.00	750.00	CPU hour
Batch	500.00	700.00	CPU hour
Priority A surcharge	750.00	750.00	CPU hour

Prime— When the job is submitted to be processed between the hours of 8:00 A.M and 7:00 P.M. (Ottawa) or between 8:30 A.M. and 7:00 P.M. (Toronto), Monday to Friday inclusive, statutory holidays excluded

Demand— When the job is submitted for processing during other than the hours defined as prime time.

Batch— When the job is scheduled by Computel, subject to a maximum turnaround of twenty-four hours.

2. Fastrand Storage	6.45	10.00	Block per month

There are 86,016 characters per fastrand block. The monthly charge is based on the greatest number of blocks allocated at any one time during the month.

B. IBM 360/65			
3. SYSTEM OCCUPANCY*			
Memory Rate	$ 1.60	$ 2.00	KB per EH
2314 Disks			
Public	5.00	5.00	MB per EH
Private	17.50	17.50	EH
2401 Tape	22.00	22.00	EH
Mark Sense Reader	19.00	19.00	EH
4. SYSTEM ACTIVITY*			
CPU	280.00	350.00	CPU hour
2314 Disks			
Record Charge	1.25	1.25	KR
Byte Transfer	.15	.15	MB
2401 Tape			
Record Charge	.15	.15	KR
Byte Transfer	.15	.15	MB
Mark Sense Reader			
Record Charge	1.25	1.25	KR
Byte Transfer	:20	.20	MB

WHERE: KB= 1024 Bytes; EH= Computed Elapsed Time; MB= 10^6 Bytes of Storage; KR= 1000 Data Blocks

		DEDICATED TERMINAL AND COMPUTING SERVICES COMMITMENT AGREEMENTS	COMPUTING SERVICES AGREEMENT	PER

5. 2316 DISKS

(i)	On-line Space	$ .65	$ .75	Track per month
(ii)	Off-Line Charges			
	Shared Private	.002	.002	Track per day
	Minimum	1.00	1.00	Month
	Non-shared Private	30.00	40.00	Month
	Disk Mounts	3.00	3.50	Each

6. Priority Factors

		CODE	% Surcharge (+) % Discount (—)
(i)	Prime shift, weekdays, 8:00 A.M. to 7:00 P.M.		
		12	+20
		11	+10
		10	+ 5
		9	0
		8	— 2
(ii)	Weekends, 8:00 A.M. to 7:00 P.M. Evenings, 7:00 P.M. to 12:00 Midnight		
		7	— 5
		6	— 7
(iii)	Weekends, 7:00 P.M. to 8:00 A.M. Night Shift, 12:00 Midnight to 7:00 A.M.		
		5	—10
		4	—12
(iv)	Scheduled by Computel as possible		
		3	—15

If no priority is indicated Code 9 will apply

7. Job Time Factors

ELAPSED TIME OF JOB	PRIME SHIFT % SURCHARGE	Weekdays, 12:00 Midnight to 8:00 A.M. Weekends, 7:00 P.M. to 8:00 A.M. % DISCOUNT
0—30 Minutes	0	0
40 Minutes	+ 8.33	—2.5
50 Minutes	+16.66	—5
60 Minutes or greater	+25	—7.5

Intermediate times are subject to interpolation.

C. UNIVAC 1108 AND IBM 360/65 COMMON CHARGES

8. Printing

Single part	$ 1.50	$ 2.00	1000 lines
Multipart	.40	.40	1000 lines per extra part

Charges are calculated to the nearest 100 lines per job

computel

9.	**Card reading**	1.00	1 00	1000 cards
10.	**Card punching**	4.00	5.00	1000 cards
11.	**Tape mounts**	1.50	2 00	each
12.	**Form changes**	2.00	2.00	each
13.	**Magnetic tape rental**	.15	15	day
14.	**Decollating and/or Bursting**			
	Ottawa — per hour	$ 10.00	$ 15 00	
	— Minimum	2.50	3 75	job
	Toronto (decollating only)	.05	05	1000 lines per part
15.	**Xerox reproduction (Ottawa only)**			
	Less than 6000 copies	.035	035	copy
	6000 to 10,000	.034	.034	copy
	Greater than 10,000	.033	.033	copy
	Minimum	3.50	3.50	job
16.	**Remote I/O charges (terminal usage)**			
	(i) I/O allowance			
	Univac 1004-I,			
	201A	8 units	6 units	
	48C	10 units	8 units	
	Univac 1004-II,			
	201A	10 units	8 units	
	48C	12 units	10 units	
	Univac 9200,			
	201A	8 units	6 units	
	48C	10 units	8 units	
	Univac 9300,			
	201A	10 units	8 units	
	48C	12 units	10 units	
	IBM 2780 and 1130	8 units	6 units	
	IBM 360/20,			
	201A	10 units	8 units	
	48C	12 units	10 units	

An I/O unit is defined as 10 cards read or 7 lines printed or 7 cards punched
For each second of 1108 CPU time or 360/65 computed elapsed time which the customer is invoiced, there is an allowance in terms of I/O for which there is no charge, which allowance is designated as I/O allowance.

	(ii) Excess I/O	$ .005	$ .010	unit

17. Plotter rates

(i) Ottawa	$25.00 per hour
Commercial	30.00 per hour
Minimum charge	5.00
(ii) Toronto	
0.0—5.0 hours	40.00 per hour
5.1—49.0 hours	35.00 per hour
Greater than 49.0 hours	30.00 per hour
Minimum charge	10.00

(iii) Common paper charges		
31 inch paper	$28.50 per roll or	$ .25 per foot
12 inch paper	8.50 per roll or	.27 per foot

D. GENERAL

18. Basis for Machine charges

(i) Univac 1108, EXEC 2

Machine Charge = (CPU×CPURAT) + I/O

Where CPU = The measured time applicable to program execution, including time during I/O operations but excluding system overhead, accumulated handling, communications and related system functions.

CPURAT = Rates indicated in Section A1, preceding.

I/O = Charges, incurred due to mounting of tapes, printing of lines, reading and punching of cards.

(ii) IBM 360/65

Machine Charge = JTF × PF (CPU + MEM + I/O)

Where JTF = Job Time Factor

PF = Priority Factor

CPU = Published Rates
Times the amount of system time used for program execution as well as the handling of job related interrupts and step controls

MEM = Published rates times the occupancy time attributable to all of the facility operations required by a user program step.

I/O = Charges accumulated on the basis of facility occupancy, facility activity, printing of lines, card reading and punching, mounting of tapes and disks, form changes.

19. Other

Items 14, 15 and 17

These items represent services provided by third party suppliers. The rates indicated are subject to change without notice.

EFFECTIVE August 1, 1970

DATALINE
40 St. Clair Avenue West
Toronto, Ontario 964-9515
DATALINE SYSTEMS LIMITED

COMPUTER UTILITY USAGE AGREEMENT

Name and Address of Customer:

Agreement Number:

Date Signed:

Date Effective:

Dataline Systems Limited ("DATALINE"), by its acceptance hereof at its Head Office, agrees to furnish to the Customer its Dataline Interactive System ("DIS") service in accordance with the terms and conditions set forth herein and in any schedule attached bearing the same agreement number as appears above. DIS service shall comprise the availability of the below listed machines and devices (collectively the "machines") and the below listed services (the "services") for the customer's use during the scheduled hours.

Equipment and Service Available for Use:

Item No.	Equipment	Type of Service*	Minimum Usage	Unit Charge	Total Charge
1	C.P.U.	Prime time		See below	$
2	C.P.U.	Off-peak		$390.00/hour	
3	C.P.U.	Weekend		$375.00/hour	
4	Connect Time	Prime Time		$10.00/hour	
5	Connect Time	Off-peak and Weekend		$7.50/hour	
				Contracted Monthly Minimum Charge	$

*See reverse for definitions.

Prime time CPU charges:

These charges are determined by the average size of each job, averaged over the total CPU time for the job. One page consists of 1,024 words of main storage.

Job Size	Rate
0—16 pages	$ 400.00 per hour
17—32 pages	$ 500.00 per hour
33—48 pages	$ 650.00 per hour
49—64 pages	$1,000.00 per hour
65 pages or more	$1,400.00 per hour

Price is independent of program size for off-peak and weekend usage.

Special Equipment Charges:

Service	Unit Charge
File Storage (On-line Program Storage Units (PSU))	
Where one PSU=640 characters	$ .20 per PSU per month
Mountable I/O Devices (charges are rounded up to the nearest tenth of an hour)	
Magnetic tape drive (7 or 9 track)	10.00 per hour
DECtape drive	3.00 per hour
Disk drive (RPO2, 25 million characters)	20.00 per hour
Calcomp 563 charges	24.00 per hour

Service	Unit Charge
Mount-Dismount	
Magnetic tape	1.00 per reel
DECtape	.25 per reel
Disk pack	2.00 per pack
I/O Charges (charges are rounded up to the nearest 100 lines or 100 cards per job)	
Line printer	$2.00 per 1,000 lines for first 2,000 lines 1.75 per 1,000 lines which are in excess of 2,000 lines
Card Reader	.50 per 1,000 cards read
Card Punch	3.50 per 1,000 cards punched

SPECIAL TERMS:

This agreement shall not be effective unless and until signed by an authorized representative of DATALINE.

All the terms and conditions appearing on the reverse hereof are included herein by reference and form an integral part of this agreement.

Accepted:
DATALINE SYSTEMS LIMITED

____
(Customer)

By _______________________
(Name)

____
(Title)

By _______________________
(Name)

____
(Title)

APPENDIX C

The SDL Billing Algorithm consists of the following elements:

1. BASIC ALGORITHM
2. Rate Reduction for PROCESSING OUTSIDE NORMAL HOURS
3. Rate Reduction for VOLUME
4. Rate Reduction for COMMITMENT
5. Rate for TERMINAL USE

1. BASIC ALGORITHM

Operation of the SDL system in a multiprogramming environment has made it necessary to develop a new approach for the accounting of a job in the system. Without multiprogramming, only one job would be processed in the system at any one time. Charges in such an operating environment are usually based on elapsed time. This means that each job has to bear the cost of the total system and, in addition, the cost of delays in operation, such as time required to mount tapes and disks.

By multiprogramming, many jobs can co-reside in the system at the same time and, therefore, each job should bear only the cost of the actual facilities it utilizes. If the same job is run several times, even under varying system loading conditions, the charges should be identical.

In order to achieve this degree of sophistication in accounting, a new form of measurement is necessary. The objective is to achieve an equitable and repeatable system of service charges. ACCOUNTPAK is a proprietary implementation which meets this objective.

The charges for computer services are detailed in the SDL Computer Services Agreement. The following description outlines the various components which comprise the Basic Algorithm.

Charges for System Usage

The Billing Algorithm establishes the Charges for System Usage by measuring and recording five factors:

(over)

a) System Activity
b) System Occupancy
c) Input/Output
d) Operator Activity
e) Supplies

a) System Activity includes charges for the components of the system which can be shared dynamically between jobs which are being processed concurrently. This type of charge applies to the central processing unit, the channels and the input/output control units.

The system activity charge for central processor activity is proportional to a measured quantity called Task Time. Task Time for a job step is the sum of the time intervals during which the central processor is actively and exclusively executing instructions for that job step.

The system activity charge for channels and control units for a job step is proportional to the input and output data traffic which that job step produces. This data traffic is determined from an actual count of the number of blocks (physical records) and bytes (characters or digits) transferred.

b) System Occupancy charges for a job step relate to those system components which are reserved exclusively by that job step. These include peripheral storage devices (tapes, disks or drums) and the region of main core memory used by the job step.

Since the SDL system is operated in a multiprogramming environment, the actual elapsed time depends not only on the job step in question but also on all other jobs being processed concurrently. Actual elapsed time, therefore, cannot be used as an equitable measure of system occupancy. Instead, a pseudo elapsed time, called Step Time, is calculated.

To perform the Step Time calculation, central processor and channel activities are monitored at periodic intervals. The largest individual increments of task time or calculated input or output time for any dataset are accumulated at each interval. Charges for core memory, or public disk or drum space are also in proportion to the number of bytes reserved for use by the job step.

c) Input/Output charges are based on the number of cards read, cards punched and lines printed. These input/output charges apply to the normal mode of operation at SDL in which card input is transferred to disk before a job step is executed and card or printer output is produced from disk after execution is completed.

If input or output is performed on privately reserved or allocated units during job step execution, these charges do not apply. Instead, a system occupancy charge is made for the private use of the card reader, card punch or printer units reserved.

d) Operator Activity charges cover activities such as mounting of private tape reels of disk packs, changing to non-standard printer forms or non-standard cards in a punch or for mounting a non-standard train on a printer.

e) Supplies of single and multiple part forms and standard cards are provided by SDL and charged on a per unit basis.

Charges for On-Line Storage

Permanently resident on-line disk storage space can be rented on an hourly or daily basis. Availability of this space must be scheduled in advance.

Charges for Storage Media

Tape reels and disk packs can, if required, be rented directly from SDL and stored on its premises. Charges for this service are on a daily basis.

2. Rate Reduction for PROCESSING OUTSIDE NORMAL HOURS

Work may be submitted by the customer for processing outside of normal SDL hours and, thus, benefit from a rate reduction.

3. Rate Reduction for VOLUME

All work processed within a month benefits from a rate reduction for volume calculated in accordance with the table contained in the SDL Computer Services Agreement.

4. Rate Reduction for COMMITMENT

Work committed for processing at SDL over a period of six months to two years qualifies for an additional rate reduction according to the table contained in the Computer Services Agreement.

5. Rate for TERMINAL USE

Terminals can be installed on customer premises and connected directly to the SDL system via communication lines. Charges for this service are dependent on terminal type, location and the type of service and may be on a monthly, hourly or per unit basis.

Schedule of Charges – BASIC ALGORITHM

CHARGES FOR SYSTEM USAGE

(a) CHARGES FOR SYSTEM ACTIVITY

Processor Activity System/360 Model 85	$1 200.00/*task hour*
Channel Activity:	
2301 Drum Traffic	$1.00/*KB* + 5c/*Mb*
2314 Disk Traffic	$1.00/*KB* + 15c/*Mb*
2420 Tape Traffic	$0.15/*KB* + 15c/*Mb*
2410 Tape Traffic	$0.15/*KB* + 25c/*Mb*

(b) CHARGES FOR SYSTEM OCCUPANCY

Core Storage	$ 2.00/*Kb/step hour*
Drum 2301 (public use)	$100.00/*Mb/step hour*
Disk 2314 (public use)	$ 5.00/*Mb/step hour*
2314 (private use)	$ 20.00/*drive/step hour*
Tape 2420	$ 25.00/*step hour*
2401	$ 15.00/*step hour*
Reader 2504 (allocated)	$ 20.00/*step hour*
Printer 1403 (allocated)	$ 20.00/*step hour*
Punch 2540 (allocated)	$ 20.00/*step hour*

(c) CHARGES FOR PERIPHERAL INPUT/OUTPUT

Card Reading	$ 1.25/*K cards*
Printing	$ 1.25/*K lines*
Card Punching	$ 3.50/*K cards*

(d) CHARGES FOR OPERATOR ACTIVITY

Tape Reel	$ 1.50/*mount*
Disk Pack	
– using SDL mount procedure	$ 2.50/*mount*
– otherwise	$ 7.50/*mount*
Non-Standard Printer Forms	$ 1.00/*change*
Non-Standard Cards - punching	$ 1.00/*change*
Non-Standard Printer Train	$ 5.00/*change*
Console Message Replies	$ 1.50/*reply*

(e) CHARGES FOR SUPPLIES

Standard Forms	$ 0.01/*page*
Standard Cards	$ 1.50/*K cards*
Multiple Part Stock Forms	$ 0.01/*page/part*

CHARGES FOR ON-LINE STORAGE

Charges in this section are in lieu of charges for System Occupancy for 2314 disk usage and charges for Operator Activity.

2314 Disk Drive	$ 12.00/*set-up* +
(by pre-arranged schedule)	$ 6.00/*elapsed hour*
2314 Disk Space	$ 3.50/*Mb/SDL working day*

CHARGES FOR STORAGE MEDIA

Tape Reel	Rental		$ 0.05/*calendar day*
	Storage		
		Normal	$ 0.02/*calendar day*
		Vault	$ 0.05/*calendar day*
		Restricted	$ 0.10/*calendar day*
	Access to Restricted Storage		$ 1.00/*access*
Disk Pack	Rental		$ 0.85/*calendar day*
	Storage		$ 0.15/*calendar day*

Abbreviations

KB – thousand blocks. A block is a physical record of data as recorded on a storage medium.

Kb – 1024 bytes of core storage.

Mb – million bytes of data.

APPENDIX C

December 3rd, 1970.

THE ECONOMIES OF INTEGRATION

COMMUNICATIONS AND DATA PROCESSING

D.D. Cowan

L. Waverman

TABLE OF CONTENTS

TERMS OF REFERENCE

The purpose of this study was to investigate the potential economies arising from the integration of the communications function and the data processing function within a single firm or entity. This paper does not investigate the impact on competition of such integration. No recommendations are made as to whether such integration should in fact be allowed. We leave that choice to the policy-maker who has all the relevant information, one piece of which is represented by this study.

Nor do we consider some of the other perhaps related issues which have been raised by either communications firms or existing data processing in companies. For example, this study does not consider the merits or demerits of the arguments that allowing unregulated message switching will lead to entry only in the most lucrative areas -- the cream skimming argument. Nor do we consider the broader national goals under which a decision must be made. We do not for example, concern ourselves (except in the question of research and development) as to the nationality of the ownership or location of the firm.

Nor do we consider this study as the final word on the economies of integration between processors and carriers. Given the time constraint (3-1/2 months), the lack of hard data and the lack of serious qualitative thought on the issue also, this document should be read as a research report. This study should be revised when and if data becomes available and when technology changes. Although we have made the best estimates we can as to the course of future technology, our best prophecy is that we will be proven wrong.

The study itself is divided into four main sections. The first part deals with the possibility of a data processing subsidiary utilizing the hardware facilities of the communications parent. In this section is discussed the possibility of handling both communications and processing on a single computer. Also discussed is the question of advantageous connection -- does the processing arm of a carrier acquire advantages because of its ability to tie directly into the message switching or toll centre of the communications firm? The second part of the paper briefly discusses the factors which may lead to economies of integration through the computer firm's utilization of the existing personnel -- sales, maintenance and management. The third division analyzes whether a processing subsidiary of a large well-known communications firm is able to borrow funds at a lower cost than would an independent computer utility. In the fourth section, the effect of integration on the research and development capability of the communications firm and the processing firm is discussed.

ECONOMIES OF INTEGRATION - TECHNICAL FACTORS

Computing and communications are somewhat inseparable terms. A communications network uses computers to switch messages, connect communication lines and concentrate messages, while a time-sharing system may perform such traditional communication functions as polling and switching.

A communications network is part of a computer utility in that the network is employed to connect users both to the computer and to mass storage and also to connect computers to each other. A computer utility, although primarily used for data processing and data bank functions, can also be considered as a communications system in that it allows various users to communicate with each other and with the services supplied by the system.

Since the communications companies employ computers for communication tasks and since computer utilities and communications networks bear a strong resemblance to each other, it has been suggested that economies might result in the communication companies were allowed to do both data processing and communication functions.

The next few paragraphs will present some of the general terminology of the use of computers in the communications networks before there is a detailed discussion of the technical factors likely to cause economies of integration.

Discussion of Terminology

Electronic Switching Systems

The computers of an electronic switching system are

used to set up a physical path between the incoming and outgoing lines. The computer itself does not handle the data transmitted, but mainly scans both incoming and outgoing lines to ensure that calls are connected and disconnected correctly. Electronic switching systems are designed and constructed to be extremely reliable and therefore include elaborate hardware and software provisions to allow recovery from errors and faults via automatic self-diagnostic analysis. 1/

Existing line switching computers do not have many of the facilities necessary for high speed data processing. The memory cycle time of the electronic switching system (SP-1 - 6 microseconds, ESS 1 - 5.5 microseconds) is far higher than the average cycle time of a modern data processing computer (IBM 360/85 - 100 nanoseconds). Line switching computers presently do not contain arithmetic units capable of multiplication or division, nor do they have means of accessing on-line storage. No standard languages, language compilers or standard operating systems have been designed for these switching processors.

1/ A.T. & T.'s E.S.S.1 is designed to have a maximum of 2 hours downtime in 40 years of operation. Of the 100,000 operating instructions controlling E.S.S.1, 50% are used for fault diagnosis and error recovery. Similar figures hold for the Canadian SP-1 system of Northern Electric.

Message Switching Systems

Unlike electronic switching systems, message switching systems do not create a physical link for the data to flow over; instead messages usually enter the system from one line, are stored and then forwarded to their destination when a line or lines to those destinations are available. Message switching with its storage capability provides better line utilization, thus reducing the overall line cost. In a modern message system, the store and forward ability is usually provided by a digital computer with an on-line storage device. Several types of digital computers are presently used in message switching systems. These are the UNIVAC 418 (Bell Canada, Western Union) and the UNIVAC 1108 (Western Union); CN/CP uses special purpose machines, the Collins C8401 (now used primarily as a reservation system for the railways), the Collins 8500 and the Philips DS714. Many of the digital computers used for message switching are general purpose processors and usually have operating systems, compilers, etc., available.

Hold and Forward Concentrators (17, p. 195)

Hold and forward concentrators are special computers which are also designed to provide better line utilization. They perform two basic functions: namely, the collection of a complete transaction (such as a single line of type) before transmission, and the execution of application programs. The use of the hold and forward concentrators for collecting transactions before transmission results in better line utilization than with the normal multiplexing technique.

The use of hold and forward concentrators (with application programs) as on-line computers also provides an effective mechanism for better line utilization. The concentrator can carry on some conversations with the user locally; line usage is reduced since some of the data does not have to be sent to the central computer.

Computing Services

Computing services presently available cover a broad range, and can be divided into many different categories by functional characteristics but can usually be thought of as special purpose and general purpose. (16. p. 8). The types of services offered on such systems can be characterised for the purpose of this study as limited data processing and general purpose computing.

Limited Data Processing

Limited data processing can be described in terms of the input data supplied to the processing computer. In this case, the input data is not to be run as a program on the processing or host machine. A program is a set of characters which will be transformed into and executed as a sequence of machine language instructions on the host computer.

General Purpose Computing

General purpose computing is defined as any task for which a digital computer program can be written.

Hybrid Services

Hybrid services are usually considered to be a combination of computing services including both message switching and data processing where a message is processed and switched. Either of these two activities may be the primary service offered with the other activity as an incidental offering. While F.C.C. regulation revolves on these notions of primary and incidental activity, they are difficult divisions to make operationally.

Integration of Data Processing and Switching Functions

It has been suggested that economies of integration might arise from the technical possibility of performing two or more functions on the same computer equipment, (not necessarily a hybrid service for the processing and switching might involve different sets of data). Thus, the integration of data processing and communications in a company might produce economies in several different ways:

(i) by allowing electronic data processing and switching to be co-resident on a computer thereby producing economies of scale 2/ and utilizing spare capacity in off-peak periods.

2/ The concept of a rule of thumb such as Grosch's Law that the computing 'power' of a computer installation increases as the square of the cost lies at the heart of belief that vast economies of scale are waiting to be tapped by the company which can create a vast 'utility' of users. Grosch's Law, best empirically measured by K.E. Knight (Datamation, September, 1966, January, 1968), has been called into serious question. Knight himself states "We cannot build larger and larger computers at reasonable costs since at any point in time there are absolute limits to the size and speed obtainable ... The most powerful computing systems we could possibly build today or tomorrow would not be the most economical." (Datamation, September, 1966, p.54). Even Knight's estimates of economies of scale exaggerate true economies because his cost estimates include the costs of operating systems, costs which rise with the size and the number of different tasks to be handled.

(ii) by utilizing the spare capacity available on a stand-by switching computer,

and

(iii) by utilizing the advantageous position that the communications company may have in connecting to its own line and message switching equipment.

These three topics will be discussed in general terms and then applied to specific computer configurations in an attempt to determine the magnitude of any resulting economies.

Integration of Data Processing and Switching Functions on a Single Processor

It has been suggested that the integration of data processing and either line or message switching on a single processor [3/] can produce savings for both activities, since the fixed costs of the machine are spread over two rather than one activity. A look at the criteria for reliability and design of present and possible computer equipment that would be used in switching systems or for data processing should reveal whether this type of integration will actually produce such an economy.

3/ From our discussions with people in the communications business, it would appear that line switching computers (A.T. & T.'s ESS and Northern Electric's SP-1) will not be used for anything but line switching in the foreseeable future. Although many of the arguments presented in this section apply to them also, we intend to concentrate primarily on message switching systems.

The operating characteristics of a communications system and a computer utility are presently quite dissimilar. The input to a communications system consists either of a number of pulses or tones followed by an analogue signal, or a string of pulses. In both cases, the input to the system has little or no effect on its reliability. Most malfunctions are caused by spurious signals such as noise or by a fault in the switching mechanisms or lines. In other words, communications systems failures are rarely caused by input data.

A general purpose computer utility on the other hand, has quite different operating characteristics. While it suffers from the same problems as a communications system, since the utility also attempts to significantly alter its input data and perhaps even allows the data to control the processor as a program, failures (especially software failures) can and do occur with far more regularity. In the ideal situation (one which is yet to be closely approximated) in a computer utility, such failures should only affect the person who caused the problem. Even here, such a failure could be catastrophic, destroying several hours work. This type of failure is certainly not characteristic of communications systems.

Reliability Criteria

It is well known that the reliability criteria for switching and processing are somewhat different under today's technology. In electronic switching systems "system outage is regarded as catastrophic; however, individual errors are not so bad." (17, p. 336). The reason that system outage is catastrophic is, of course, the fact that we have

come to regard telecommunications capability both through telephone and message switching [4/] as an almost essential service. Therefore, the entire community cannot tolerate a period when such service does not exist.

At present, general purpose data processing requirements have almost the reverse criteria. Random errors are very serious, while complete system failure is not catastrophic.

A random error in the switching function usually means that a few subscribers re-dial while systems failure may destroy a large number of conversations in a large section of the country.[5/]

Reliability criteria for errors in transmission are, of course, very different for voice and data communications. A random error caused by noise will affect the quality of conversation, but voice communications will not be radically affected (i.e. a small short disturbance in a long spoken message will not change the content of the message). In the case of data transmission, however, noise introduced

---

4/ Since non-military message switching is not as essential today as the telephone system, one suspects that system outage is not quite so disastrous. In non-military message switching the degree of catastrophe is perhaps more application-dependent than in the telephone system.

5/ The costs of crashing a switching system vary among systems. For example, A.T. & T.'s E.S.S.1 operates by maintaining a map in memory of the entire system network. A malfunction therefore, destroys all the links. Northern Electric's SP1 does not operate on this 'map' basis, and a crash destroys only those calls in the process of being connected. The crash of a message switching computer destroys the content of all messages which are in the process of being stored or forwarded.

into the line while transmitting data can cause errors which could be quite serious. At the present time, most systems appear to error-check data received to ensure that it has been received correctly.

Random errors in processing cannot be tolerated since their presence does not become known and may be propagated through many hours of computation thereby completely destroying the validity of any answers.

At the present time, a significant and lengthy system crash can be tolerated since it is fairly easy to recover from such crashes without too much loss of data; our tolerance of such crashes, however, is decreasing as business comes to rely more and more on access to computer facilities in its day-to-day activities. It would appear then, that although a communications system can tolerate some random errors and no system crashes, the computer utility in the future will probably be at least as stringent (if not more so) in its reliability requirements as the communications system.

The software and hardware presently used in data processing systems are such that fairly frequent system crashes do occur. Therefore, at present, it would be an intolerable situation to allow general purpose data processing and switching functions to reside on the same machine; however, limited data processing with carefully written and tested programs should be feasible. [6/] Certainly, the user must not

---

6/ Intolerable in that expected crashes would increase and thus total costs. Appendix I explores this area more fully.

be allowed to generate or modify code for the machine. Since future requirements on computer utilities probably will be as stringent as communications systems, and software and hardware used in a computer utility will become more reliable, we anticipate that it may be possible for communications functions and general purpose data processing functions to reside on the same computer. However, considering the problems we have today designing large operating systems, we would anticipate a delay of some years before general co-existence is feasible. 7/

Design Criteria

It was mentioned previously that the input data to a communications system and a computer utility would be manipulated in a completely different manner and would have a different effect on the computer and communications system.

In particular, in a line switching or message switching system, the input data is transferred from input to output while in a general purpose computer utility, the input data may actually be a program which will be allowed to control the computer. These constraints on the input data can make the design of switching computers and general purpose computers quite different. In the case of switching computers, the volume of data is well-known and therefore the design problem is specified. In the case of the computer utility, the nature of the input data is so ill-defined that all cases cannot be enumerated or

---

7/ A continual problem will be the divergence between social and private costs. The individual crashing the system is not asked to bear the costs incurred by the third parties whose conversations are also destroyed. Thus private costs of crashing a system are less than the costs to society of such crashes. As a result, too many crashes will occur.

even anticipated. Therefore, the design becomes more general and introduces many added features such as paging, segmentation and memory protection in order to handle many different problems. From this discussion, it would appear that the general purpose computing and switching functions should not reside on the same computer.

It should be clear from the presentation to this point, that although general purpose computing should not be on the same computer as switching; well-defined data processing tasks use time which must be stolen from the communications function of the computer, thereby limiting the number of terminals it can handle at any given instant. Also systems design is significantly simplified by specializing the jobs to be done. Therefore, in a large system, the amount of data processing done in the message switching processor should be severely limited or completely curtailed.[8/] This means that the two tasks should really be run on separate but interconnected computers.

Numerous discussions and observations have led us to this conclusion reached in the previous paragraph. The presence of specialized electronic and message switching computers suggests that there are advantages to specializing the technology for switching away from general purpose computers. Three companies (CN/CP, Northern Electric and Western Union) stated that it is less expensive to split the communications and processing tasks and to process them on two

---

8/ A message switching system with a relatively light load such as a specialized application might also be able to accomplish significant data processing tasks.

interconnected machines, one of which was a specialized switcher.[9/] Of course, reliability considerations, at least for the present, also point the way to separation of the tasks of switching and general purpose data processing on different interconnected computers.

To conclude this discussion, it appears that since switching and processing should be offered on two separate but interconnected computers, (a fact which appears to be forced by both reliability and design considerations), no economies of scale or economies from use during off-peak loads can occur.

Utilization of Spare Capacity on a Standby Computer

Electronic switching and message switching systems have spare capacity. The spare capacity exists in two ways: first, the machines are installed with the capacity to handle peak load traffic. Therefore, at times other than peak loads, these operating processors have spare capacity (this was discussed in the section on integration of data processing and switching functions on a single process). Second, both electronic switching systems and message switching systems maintain spare processors for reliability purposes. In the case of line-switching, two computers often are operated in parallel so that a continual check on the status of the system can be maintained. Message switching systems on the other hand, contain a

---

9/ "In the case where there is a significant communications load to be processed, it is more feasible to interface the communications terminal with a separate computer, dedicated to communications functions, which is, in turn, coupled to a processor dedicated to computational and retrieval functions." Western Union, Response of Western Union Telegraph Company, before the F.C.C. Docket No. 16979, March 5, 1968.

fall-back processor for every two (CN/CP) or three (Western Union) operating processors.[10/] This scheme is used so as to minimize any serious system outage.

It has therefore been argued mainly by Western Union, that allowing telecommunications utilities to offer data processing services will generate economies of integration by spreading the overhead of the spare message switching computer over both communications and processing. Of course, such data processing services will have to be on an interruptable basis since at any time, the stand-by processor may be asked to take over the switching function. It would appear that in this case, assuming the use of a general purpose computer for message switching (perhaps not a valid assumption) that some economies of integration would arise. Although no specific figures are readily available, it would appear that these economies would be rather small. Total investment in computers in a message switching system is rather small compared to the cost of the entire network, and as the number of computers in a message system increase, there may be fewer and fewer stand-by computers. In the future, the failure of one computer system may be relieved by distributing the load of the failed computer over other computers in the remaining message switching network.

10/ Western Union feels that this spare computer will be used only 5% of the time for switching purposes.

Advantageous Interconnection

Single company ownership of both the message switching computer and data processing computer may produce economic advantages, since the two interconnected computers can be placed close together, thereby almost eliminating transmission costs between the two machines.

Consider a message switching system with attached data processor. If these were both in the same company (not necessarily a communications company) and physically close to each other (within 50 to 100 feet), then a message which required some data processing would travel the path shown in Figure I.[11/]

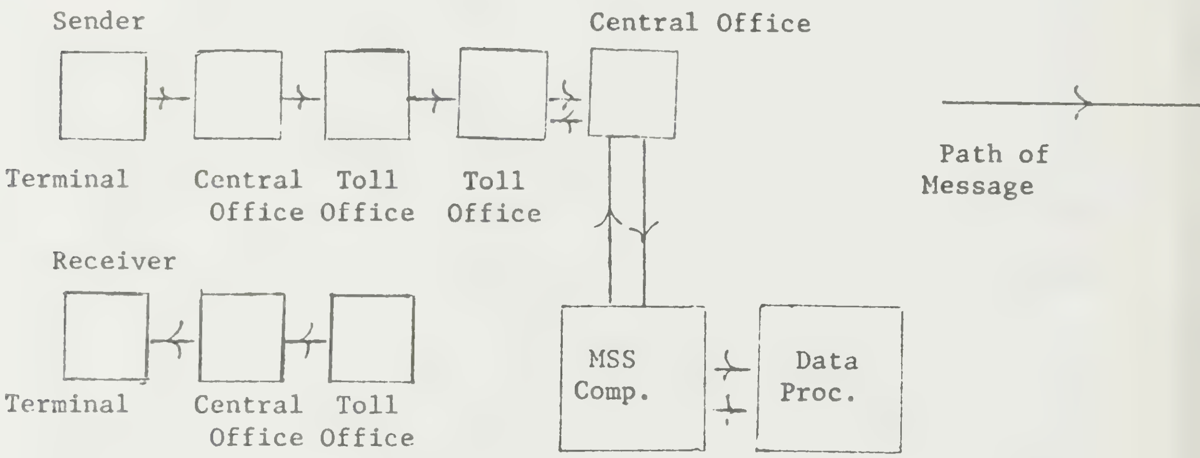


Figure I

11/ It is assumed that the message switching computer(s) and the data processing computer(s) are close together and do not use telecommunications links to transmit data between themselves. This assumption may not be correct.

If the message switching computer and the data processing computer were in different companies (perhaps in different cities), then a message which required some data processing might travel the path shown in Figure II.

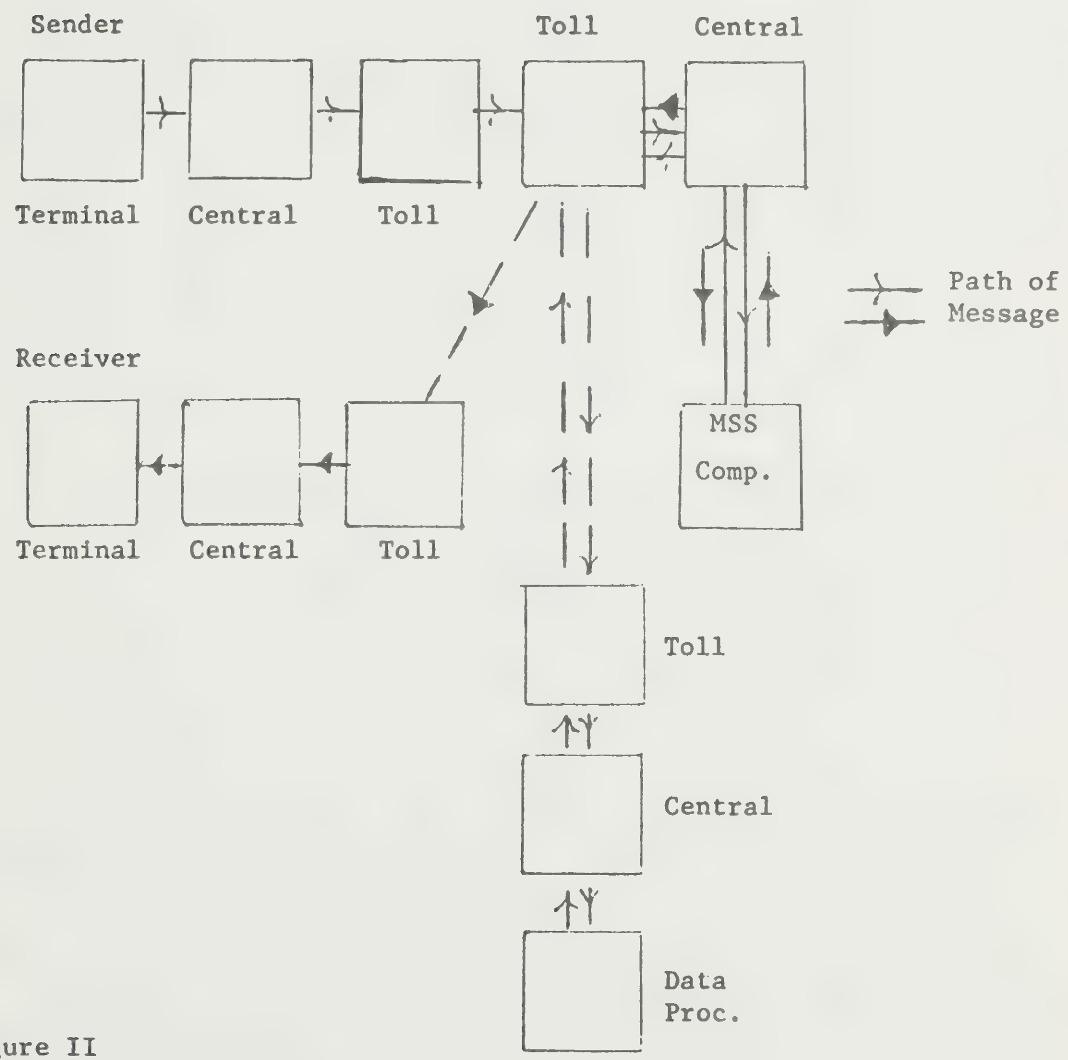


Figure II

The number of toll offices shown in Figures I and II may vary considerably, depending upon the communication distances between transmitting and receiving terminals and the data-processing computer. Of course, no switching may be required if the computers are connected by a private line.

The costs for a communication link between the two computers are given in Table I. These are the costs for intracity transmission and Multicom (intercity transmission) for a period of one month at an average daily two-way transmission rate of 600×10^6 bits per day. Table II gives these costs for a five-year period, the normal depreciation period for a computer.

Table III presents the marginal economies of integration after table II has been adjusted by the five-year monthly rental of a short direct communications link.

Such a discussion would seem to indicate that substantial economies of integration exist in advantageous interconnection, although only if the computers are separated by large distances, since in intracity transmission costs appear to be quite low. However, this is not an argument suggesting that existing communications firms have an advantage over independent utilities in offering processing services. From Table II, it can be seen that the company which incorporates switching and processing at the same location can save $1,000,000.00 over a company 200 miles away at a transmission rate of 6×10^8 bits. If all the customers for data processing services were in Toronto, then the utility located in

Transmission Rate in Kilobits /second — Mileage	19.2	50
Intracity		3400
Up to 200	22292	17550
200 - 425	28012	21950
425 - 650	33754	26350
650 - 1000	38474	30750
1000 - 1400	45216	35150
1400 -	48076	37350

Monthly Charge for an Average
Daily Transmission of 6×10^8 bits

Table I

Mileage \ Transmission Rate	19.2	50
Intracity		204
Up to 200	1340	1054
200 - 425	1680	1310
425 - 650	2030	1580
650 - 1000	2300	1850
1000 - 1400	2710	2110
1400 -	2880	2240

Charges for 5 years for Multicom Service for
An Average Daily Transmission of 6×10^8 bits
in thousands of dollars.

Table II

Mileage \ Transmission Rate	19.2	50
Intracity		187
Up to 200	1320	1030
200 - 425	1660	1290
425 - 650	2010	1560
650 - 1000	2280	1830
1000 - 1400	2690	2090
1400 -	2860	2220

Marginal Economies over 5 years for an
Average Daily Transmission of 6×10^8 bits
in thousands of dollars

Table III

Toronto would have costs $200,000.00 a year lower than its competitor in Ottawa. Note however that the only savings that a communications firm which located its processing unit in Toronto would have over a Toronto based utility would be approximately $40,000.00 per year (the cost of intracity transmission). This saving of $200,000.00 per year is available to any utility which located in the neighbourhood of its customers. If all customers were in Toronto, it is unlikely that any utility would locate outside that city. This $200,000.00 annual savings is not an economy of integration but it merely represents the savings available to the firm which best discerns the market.

Up to this point, this section has considered only configurations of two computers. Consider the distributed network in Figure III which consists of four message switching computers and two data processing computers.

Here the data processing computers are part of a large computer network and data is sent to them for processing purposes as it moves through the network. Of course, some of the data in the network may be passed on as a 'pure' message while other messages may be transformed or generate special data using the data processing computers.

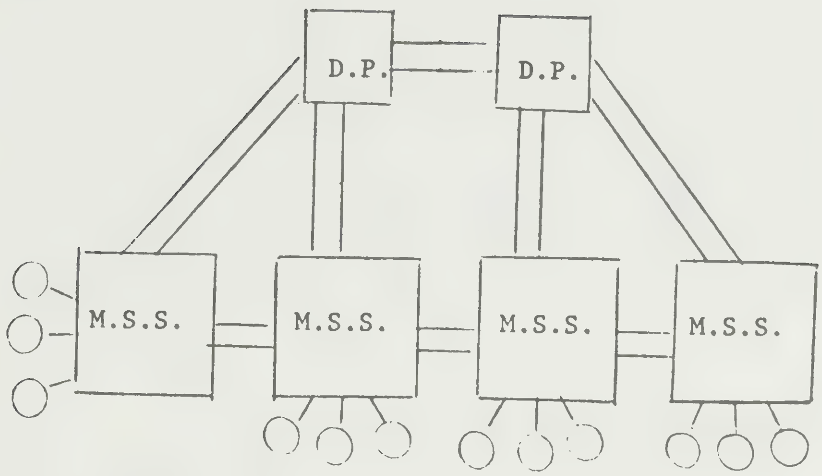


Figure III

Such a network is perhaps more realistic than the simple interconnection that was shown in Figures I and II. Since there would probably be many different areas of the country wishing to use such a system, it might be reasonable to centralize all dynamic files and do most of the data processing on a large centralized computer to take advantage of economies of scale.

The message switching computers on the other hand, may be relatively small but rather numerous in order to provide better line utilization and thereby reduce transmission costs.[12/]

12/ This statement assumes, of course, that the present trends will continue i.e. costs of computation are decreasing rapidly while transmission costs remain quite high.

In such a distributed network, it would be expected that the optimum location for the data processing computer would be dependent upon the geographical distribution of the data transmission traffic and transmission costs. It is very difficult to assess where it should be located since the computation of transmission costs for any network such as this, are quite complex and beyond the scope of this report. It may well be that the data processing computers should be in a location remote from any of the message switching machines in order to minimize transmission costs.

Potential Economies from Technical Factors

The next several paragraphs deal with possible computer-communication configurations in an attempt to summarize the conclusions of this section.

A number of assumptions have been made about the capability of individual companies to provide communications services of various kinds. These are described in the next few paragraphs and will be assumed unless stated otherwise.

Assumptions

It is assumed that:

(i) Any company can obtain the same communications services as the communications firm can supply itself.

(ii) As a consequence of (i), that any company can obtain a computer and offer a message switching service.

and

(iii) The communications firms are the only companies allowed to offer line switching service.

Assumption (i) implies that a situation similar to the one which gave Western Union (SICOM) an advantage over Bunker-Ramo (Telequote) could not occur. (19, p.73) In this case, Western Union was providing a cheaper communications service to its own system (SICOM) than it was to its customers, Bunker-Ramo, and Scantlin Electronics. This cheaper service was not an economy of integration, but rather an abuse of its monopolistic position.

Sample Cases

A number of examples will be examined to see if technical economies of integration exist in various configurations of line switching and message switching systems.

Case I Message Switching and Data Processing on the Same Computer.

This situation should only arise when (i) a very limited data processing load exists which can be run in conjunction with a message switching service, or (ii) a message switching service with a small load and limited data processing can absorb some of the spare time without hampering the message service.

In both cases, the reliability and design criteria would severely limit the data processing load. Under the assumptions made at the beginning of this section,

it would appear that under the ownership by one company, both communication costs and computer costs should be the same for the same services.

The only economies that might occur would be small economies of scale where the new service might be integrated with the already existing Public Message Service.

Case II Message Switching and Data Processing on Two Separate Interconnected Computers.

If the message switching and data processing are performed on two separate but interconnected computers, then there are two suggested configurations of equipment as shown in Figure I and Figure II. In Figure I the two computers are in the same company and located close together. This represents the most economical configuration since the communication distances are short and data might be transmitted over a dedicated cable.

Figure II represents the configuration of equipment when the computers are separated by a significant distance. In this case, the data must travel over a communication line between the message switching computer and data processing computer at least twice. The marginal economies here are represented by the difference between communication costs over a five-year period (the

usual depreciation period for a computer) and the rental of the direct link represented in Figure I. These marginal economies were given in Table III.

If the two computers connected together, have a five-year depreciation period and the data processing machine initially costs a total of $4,000,000.00 then the marginal economy from advantageous interconnection would be about 4.7% ($187,000.00 approx.), if 50 kilobit transmission was used.

By having the two computers located next to each other, there may be some economies associated with reliability of service. If we assume that the data processing and message switching computers are the same type, then probably only one computer needs to be available for standby service. If the computers are owned by separate companies, then at least one extra standby computer will be required for high reliability service.

Of course, there are two points to be raised here. Will the message switcher and the data processor both be the same type of computer? It is not clear that this would be an optimum design decision. Also since the message switcher is a store and forward system, can it retain all data processing tasks when the data processing computer is being serviced. Such a situation would obviate the need for a standby computer. Of course, the need for a standby machine is highly application-dependent and it would be difficult to discover if there are any economies here without looking at the reliability requirements of individual applications.

Summary and Conclusions

This section has examined technical factors which influence the design and implemention of computer systems which offer both communications and data processing services. It has defined the terms associated with this subject and considered the problem areas.

In particular it has examined -

(i) reliability criteria

(ii) design criteria

and

(iii) interconnection of computers.

We have concluded that communication functions and data processing should probably be implemented on different interconnected computers except where the data processing functions are very limited or where the message switching load is very light. This conclusion was borne out by the actual practices of many of the communications firms.

Since these functions were to be carried out on interconnected computers, we examined the methods of interconnection in order to determine if the communications companies could realize an economic advantage in this situation.

An investigation of two interconnected computers led us to conclude that small economies would result if the two computers

were not remote from each other since communication costs would definitely increase the cost of the total message switching-data processing package.

An examination of the more general network problem indicates that it is not clear if any interconnection advantages exist since the "best" possible location for a data processing computer may be remote from the message switching computers. Economies caused by interconnection advantages are in fact, dependent on both the applications under consideration and the density of data transmission.

It would appear from a consideration of the technical factors involved in computing and communications, that any economies of integration are associated with advantages of interconnection. It is not clear in many cases whether such advantages exist. A comprehensive study of various computer networks might provide a more definitive answer.

TECHNICAL, SALES AND MANAGEMENT CAPABILITY

Three potential economies of integration mentioned are the economies of utilizing more fully the existing technical sales and management capability of the communications firms. These firms, it is argued, have extensive technical staffs which could be used with a minimum of training to maintain both existing equipment and additional data processing equipment. (The economy of technical integration on the research and development side will be discussed later.) While maintenance expenses are a significant portion of the operating costs,[13/] (20% to 30%), for there to be an economy of integration in this area, the carrier must have an excess maintenance staff which would have the time necessary to maintain data processing equipment. This staff must also have the necessary skills to repair and maintain sophisticated data processing hardware or be able to acquire these skills with a minimum of expense, so that combining communications and data processing in one firm would result in a lower maintenance expenditure for this combined firm as compared to two separate companies.

The estimates of maintenance costs given in the above paragraph are the costs incurred in maintaining the entire communications system i.e. local loops, microwave and coaxial equipment, terminals and switching equipment. It is obvious that maintaining a wire pair or microwave antenna or a telephone handset bears little resemblance to the maintenance required for sophisticated computer hardware. The President's

---

13/ For example, in 1968, Bell Canada spent $131 million dollars on maintenance or 28% of its total operating expense budget.

Committee on Communications Policy suggested that out of the total cost of the telephone network, long distance transmission represents 17%, terminals 23%, local loops 15% and switching 45%. (20, p. 7)

If maintenance expenses for each of the functions of communications firms are incurred in proportion to the amount of the total network invested in such functions, then at most 45% of total maintenance costs are incurred for switching equipment. However, even this figure exaggerates the costs of maintaining electronic switching machines since the maintenance of step-by-step or cross-bar switching equipment is also very unlike the maintenance of a large scale computer system. It is only the proportion of the cost which is incurred in maintaining electronic switching equipment which represents an area available for integration savings. Assuming that 20% of total switching maintenance costs is applicable to electronic switching equipment is probably an exaggeration but can be used to show the magnitude of possible economies of integration. Under this assumption, 9% of all maintenance costs are open to integration economies (.20 x .45) or 2-3% of all operating costs (.09 x .30).

Table IV presents estimates of the relationship of maintenance costs to total rental costs for the major components of an average general purpose computer. While maintenance costs are as significant for general data processing machines as electronic switching equipment, general processing maintenance costs are expected to decline as computers become more self-diagnostic.

TABLE IV

Category	Maintenance Cost as a Percentage of Total Rental
Core Storage	6.7%
Central processors with core storage	7.2%
Controllers	8.4%
Central processors with no core storage	10.8%
Drums	12.4%
Disks	14.6%
Mass storage devices	15.5%
Tape Drives	16.2%
Card readers and punches	19.8%
Printers	20.0%

Source: W.F. Sharpe, The Economics of Computers, p. 275.

One question is whether in fact carriers do have excess technical staff and if these technicians have the skills necessary to maintain large scale data processing installations. We have no data to answer whether such spare capacity exists. As was suggested earlier, electronic switching systems are extremely reliable. When an error or breakdown occurs, elaborate self-diagnostic procedures are used in tracing the breakdown and technical maintenance of electronic switching equipment involves repairing a comprehensive known error. The maintenance of data processing equipment is far more a matter of isolating the problem than actual repair. At this time therefore, the requirements of technical maintenance for electronic switching systems and large data processing installations are different and thus diminishes the possibility of achieving economies of integration today. The introduction of general purpose computers for message switching purposes increases the possibility of achieving maintenance economies although the reliability of a machine's operating system is presently different when the machine is used solely for message switching than when it is used solely for data processing.

Economies resulting from integration in the sales and management force areas can be analysed in a fashion similar to the above discussion. The possibility of economies rests on the ability of the existing sales and management staffs to handle new ventures. This ability itself depends on the number of people or the time available for data processing and whether the existing staff has the skills to handle this new function. The degree to which economies will be possible then depends on the type of data processing service being offered by the carrier. For example, if the carrier offered a simple calculator

service which would be utilized by any touchtone telephone, then the business office representative who sells coloured Princess phones could easily sell this new service as well. If the service offered was a large scientific program to be used by major oil companies then it is unlikely that the existing sales force would be competent enough in the specific area to adequately represent and sell this program.

While the possibility of economies of integration in sales is present, no measure of its possible magnitude can be made since there is little information available on the type of data processing service which would be offered, the size of the existing sales force and the cost of sales and promotion.

The economies of management are traditionally mentioned in all studies of integration and scale economies. One company rather than two avoids the duplication of bureaucratic structure of president, officer and directors, etc. In 1968, the aggregate direct renumeration of the directors and senior officers of Bell Canada was $1.3 million dollars or 0.2% of total costs. Savings on management would therefore not appear to be very significant. A related issue pertaining to management economies is not directly concerned with the pure savings of dollars achieved through aggregating bureaucracies but in the management talent which a large company has and small companies may be unable to find, afford or exploit. We make no judgments on the relative capabilities of carrier management as compared to the management of private data processing firms.

FINANCE

It is widely believed that a large diversified company can by issuing its own securities (debt or equity) finance a new subsidiary (say, in data processing) of size X and risk σ_X at a lower cost of capital than an independent processing firm of identical size X and risk σ_X. This belief therefore implies that investors prefer to purchase the securities package of a large, safe company, with a risky subsidiary to the alternative of buying separately the securities of a large safe company and the securities of a risky company.

In addition, risk elements aside, it is believed that a large company can issue securities at a lower cost of capital than can a smaller company.[14/] Therefore, these two reasons -- risk and scale -- are used to suggest that the economies of integration between a communications firm and a data processing frim would yield substantial advantages for the integrated processor which are unavailable to the independent.[15/]

There is no doubt that overall costs of capital differ. The cost of capital in some sense is a function of the overall business risk of the company (i.e. the risk of the net operating income). A

14/ A third element, the transactions costs of a securities issue which are not a function of the size of the issue, leads to lower per unit costs of financing for large versus small firms. This economy will be discussed later.

15/ There are, in fact, data processing firms which are the subsidiaries of large, non-communications firms (General Electric, IBM). Differences in scale economies between these firms and Canadian communications firms are not large. Therefore, arguments that a data processing subsidiary of a communications firm would have a lower cost of capital than these other integrated processors rests on some subjective analysis of the relative risk inherent in the respective parents.

large diversified company can be thought of as a weighted average of smaller companies each with its own risk. If the earnings streams of the subsidiaries are not perfectly correlated then the overall risk of the total earnings of the company will be reduced by diversification. However, a distinction must be made between the overall risk (or the overall cost of capital) and the marginal risk (or the marginal cost of capital). The marginal risk is the increase in risk due to adding another risky earnings stream. The fact that Canadian communications firms have lower overall costs of capital than do independent processing firms does not imply that the communications firm should have a lower marginal cost of capital in offering processing services than the cost of capital of independent data processors.

The average (overall) cost of capital is the mean cost per unit of capital inflow. The marginal cost of capital is the cost of the last unit or project to be added to the company. In this case, while the utility's average cost of capital is low because of the low overall risk in the area where it has a monopoly -- communications, the utility's marginal cost of capital for a new data processing project is higher than the average cost of capital because of the risk in competitive data processing which is not inherent in monopolized telecommunications. If there are no reasons why the data processing subsidiary of a telecommunications firm has a lower risk than an independent processor, then the cost of capital to the communications firm for this subsidiary should be no different than the cost of capital to the independent firm.

In order to understand this point let us define first the marginal cost of capital as the implicit cost of raising funds (debt and equity) and determined so that the current shareholders are no worse off after the investment of the funds at the rate of return equal to the marginal cost of capital. The marginal cost of capital can be considered a minimum rate of return that the investment project (in this case the offering by the communications firm of data processing) must earn. The cut-off rate used will depend on the risk of a data processor. This risk is therefore the same regardless of who undertakes the project, i.e. IBM, Bell Canada or an independent data processor, unless it can be shown that the communications firm cum processor has advantages over an independent computer utility (which we disproved in an earlier section). Therefore, we can conclude that a communications firm does not have an inherent advantage due to its diversified status in issuing securities for a data processing subsidiary; since the marginal costs of capital are equal and the issue prices and returns of the securities should reflect this fact.[16/] In other words, if the market is composed of rational investors, the investors do not prefer corporate diversification to personal diversification. Abstracting from true economies of scale, the individual investor can obtain the same degree of diversification as a large integrated firm and will not pay a premium (i.e. give the integrated firm a lower marginal cost of capital) to purchase the diversified earnings stream (3,4).

16/ While Bell common stock has changed little in the past six months, the shares of its subsidiary Microsystems International have dropped over 50% suggesting that investors do look at marginal not overall risk.

There is another common misunderstanding which would imply that the communication firm's marginal cost of capital is less than that of an independent data processor. Suppose the communications firm can issue debt at a 5% cost while their stock is selling to yield a 15% return to the investor. Assuming that interest payments are not tax deductible and the firm issues debt at 5%, the marginal cost of capital is not 5% but greater. Due to the issuance of debt the earnings stream of the existing shareholders becomes riskier and therefore the shareholders require a higher realized return to offset the increased risk. If the debt-equity ratio is unity, the marginal cost of capital is 10% and made up of the cost of debt funds and the implicit cost of equity funds. Therefore the cost of capital is <u>not</u> the cost at which funds are raised. (7) Even if the tax-deductivility of interest payments are introduced, the marginal cost of capital is not equal to the explicit cost of the funds raised.

Armed with this knowledge of the cost of capital we will determine the extent of economies of integration for the communications firm under various assumptions regarding the method used to finance its data processing subsidiary and the size of its subsidiary <u>vis-a-vis</u> its competitors.

I. <u>Independent Subsidiary, All Processors of Equal Size</u>

Assume that the subsidiary is independently financed (i.e. its own capital structure), there are no production economies of

scale, and the subsidiary and its competitors are of the same size and risk. To raise funds the processing (subsidiary and independent) companies issue stock at a cost of capital of σ^K where σ^K is the after-tax cost of capital to firms of risk K. This cost of capital is the same to the subsidiary of the communications firm and to its competitors since it is the risk of the net operating income which is the crucial factor in determining σ_T^K and this risk is the same.

If the companies issued debt instead of stock, the cost of capital is $\sigma^K(1\text{-}TL)$ where T is the marginal tax rate and L is the long run ratio of the proportion of debt used to finance investments (7) 17/ This cost of capital when debt financing is used is less than the cost of capital when using equity issues. To the extent that L is the same for the subsidiary and its competitors the costs of capital will be identical. However, L is determined by management and may differ for each company in the data processing field. A priori there is no reason to believe that the subsidiary in the long run will have a greater propensity for debt (lower cost of capital) than its competitors. However, in the short-run the subsidiary's debt-equity ratio may be greater than that of independents since a new company will initially issue equity and shy away from issuing debt since debt will be purchased only if debt holders

---

17/ Some companies in the long-run wish to finance 50% of their assets by using debt. This does not mean each investment is financed by 50% and 50% equity but that in the long run their capital structure will be half debt, half equity.

can place some important constraints on the behaviour of the company (e.g. payment of dividends, kinds of investments, etc.) However, the subsidiary may be able to use the parent's reputation to ensure that these restrictions are minimal and in the short-run, the possible debt-equity ratio may well be higher for the subsidiary than for the independents. In the long run, the new independent companies will move to their target L, and since the cost of capital depends on L there will be no gain to being a subsidiary, as long as the differences in debt equity ratios between independent and integrated processors are not functions of integration itself.

II. Independent Subsidiary, Subsidiary larger than Independents

Assume that all data processing companies issue equity, but that the subsidiary's issue is larger than its competitors. Since the issue is sold through an investment banker a fee must be paid. Let this fee be θ, measured as a percent of the dollar value of the issue. To the extent that there are economies of scale in issuing equity, $\theta_B < \theta$ where θ_B is the cost to the subsidiary and θ the cost to the competitors. Therefore the larger issue would have a lower cost of capital.[18/] However, the difference between θ_B and θ is usually small. There are two theoretical arguments on the effect of the size of the issue on the cost of equity capital. First we have the perfect market proponents who would argue that the size of the issue does not affect the cost of capital. A large issue can be sold at the same price as a smaller issue. On the other hand there are the imperfect market proponents

---

18/ Since the cost of capital (net of fees) to the subsidiary is $\sigma^K/(1-\theta_B)$ and to the independents $\sigma^K(1-\theta)$ where $\theta_B < \theta$, $\sigma^K/(1-\theta_B) < \sigma^K/(1-\theta)$.

who argue that the larger the equity issue the lower the price. Therefore the cost of capital is greater for larger issues. The empirical evidence is mixed. Johnson (8) finds that the size of the issue is not important in determining the price of an issue. Archer and Faerber (1) however, find that the cost of capital is negatively related to the issue size; this result is inconsistent with both the perfect and imperfect market hypotheses. Therefore, a firm conclusion cannot be made on the effect of the size of the issue on the cost of capital. However, there is considerable evidence to support the perfect markets hypothesis and *a priori* we would lean toward their analysis that size of the issue is immaterial in determining the cost of capital.

III Completely Integrated Subsidiary

The last alternative we will investigate is that the communications firm incorporates a data processing subsidiary directly into its capital structure and issues its own debt or equity to finance the new company. This company is identical in size and risk to its existing competitors in the capital market.

The solution to this problem has already been presented; the marginal costs of capital are identical. The investing public will not pay a premium for the new package of communication firm *cum* data processor, over the independent purchases of stock in a communications firm and in a data processing firm. This case is introduced, however, to consider another problem, the effect of the size of the company issuing the securities. It is possible that if the communications firm

is very large relative to independent processors the marginal cost of capital is less than the marginal cost for the independent data processors. The empirical evidence on this problem seems to indicate that the absolute size of the company issuing the equity does not have any effect on the cost of capital (1,6).

Summary - Finance

To the extent that economies of scale in production are absent, whether the communications firm financed its data processing firm as a subsidiary or as an independent company, there are no economies to be gained *vis-a-vis* the existing data processing companies. The marginal cost of capital will be the same for all companies since the risk is the same. The only economies that could be obtained by the communications firm would occur if the subsidiary were financed by a large equity issue since there may be some economies of scale in stock financing. However, the size of these economies of scale are not major. If they were, the economies would be available to all companies which had the same sized issue. Therefore, any new competitors in the data processing field would have larger equity issue.

The introduction of economies of scale in production would not affect the marginal cost of capital. The price paid per share for the equity issue would reflect the higher expected earnings and the marginal cost of capital remains unchanged. The price per dollar of expected earnings is equal to the inverse of the cost of

capital and scale economies have no impact on the capital market price of earnings.

i.e. $P_1 = X_1/\sigma^K$ where X_1 is earnings of subsidiary without economies

$P_1' = X_1'/\sigma^K/\sigma$ where X_1' is the earnings of subsidiary with economies of scale present, $X_1' > X_1$ and P_1' is the price per share if there are economies of scale.

and $P_1/X_1 = P_1'/X_1' = 1/\sigma^K$.

Finally, there is one reason why a subsidiary of a known communications firm may have a lower cost of capital than a new unknown independent processor; there could be imperfect information among investors. While investors may have no reasons to believe that a subsidiary of a communications firm had any advantages over its independent competitors, the investors still have the proven record of the management of the communications firm in other ventures as compared to the unknown talent of the managers of the new independent processing firm. This 'track record' could well lead to a lower cost of capital for the subsidiary. In addition, the ability to raise money at the minimum rate may depend not only on what you do but who you know. The managers, officers and directors of a larger established communications firm will have all the necessary contacts, contacts which may escape the managers of the smaller, independent processor. It is difficult to evaluate these effects on the cost of

capital, but they are small. The capital market is the nearest market to the economist's dream of perfect markets and investors are rational; if they were irrational in a perfect or near perfect market, they would not remain investors but would become paupers. We therefore expect that the subsidiary of a communications firm could attract capital at a rate only marginally lower than an independent processing firm.

ECONOMIES OF RESEARCH AND DEVELOPMENT

It is argued that the juxtaposition of processing and communications in one firm will result in significant economies of scale in research and development in a number of ways. First, unnecessary duplication of research and development expenditures will be avoided. Secondly, an operation under one roof, so to speak, allows the free flow of information and testing of ideas which are so important in adequate innovation. Third, there are substantial economies of scale in R & D, and communications firms are larger than independent processors. Finally, the carriers have established skills in electronics research and development including sophisticated electronic switching machines. To maximize Canadian expertise in this area, it would be unwise to refuse the firms with the largest established research and development activities, the right to enter the area. Each of these points will be discussed below. The first necessary question is to enunciate exactly the connection between data processing equipment and communications equipment which requires integration so that developments in either data processing or communications ensue.

Communications facilities affect the computer only when distant terminals must be connected to the processor. When this occurs, the data processor is dependent on the ability of the communications network to forward the data without error and at the fastest possible speed at minimum cost. A carrier need not however be a data processor to realize the problems of transmission, since the complaints voiced by data firms involve transmission and not processing. In addition, it is

difficult to see how being a processor will yield more information to the communications firm on the problems of a low speed high frequency analog voice system for data use. We do not feel that being a processor would add significantly to the research and development ability of a carrier to innovate better modems, etc., since the problem is one of interface and the problems of interface are well catalogued. That the carrier cum processor would develop new processing tools (rather than the new carrier tools as described above), is also of probable negligible importance. It is difficult to envision any possible changes in information flows or risks resulting in new hardware emanating from the merging of communications and processing in one firm. The carriers themselves already have large internal processing departments, many of which are interactive systems and yet communications firms have not developed better ways to build either mousetrap (i.e. processor or transmission device), it is therefore unlikely that the addition of processing which is to be offered outside the carrier will lead to any new such economies.

Returning to the general question of whether the greater size and increased diversification of communications firms cum processors will generate substantial economies in research and development, the evidence is inconclusive but tends to show few such economies. It has been argued that only the very large firm can afford R & D and that therefore there are substantial scale economies. (9) Quantitative evidence shows in general slight scale economies up to a

minimal scale of firm and thereafter negligible or decreased economies (10, 11, 12). Moreover, the change in the size of communications firms resulting from entry into data processing is hardly significant enough to generate new scale economies in R & D where none existed before. The arguments on the impact of diverisification suggest that the ability to counterbalance different risks and uncertainties leads to economies of diversification in R & D (13). Again, available quantitative evidence is inconclusive with various studies showing contradictory results (12, 14). The available literature on the effects of monopoly power, concentration and barriers to entry on R & D activity does suggest a slight positive effect on research of market dominance (12, 15).

However, the relevant issue is that Bell Canada and Northern Electric do have significant research departments and the degree to which they direct their efforts in the computer field will be a function of the degree of business which computers and data processing offers the two companies. It is therefore unlikely that while any economies per se of research and development will occur, integration would direct research efforts in Northern Electric and Bell towards data processing.

OTHER POSSIBLE CONFIGURATIONS

This report, up to this point, has discussed possible savings emanating from economies of integration in the internal operations of a communicator cum processor. This section will deal with the savings which may accrue to the customer of a processing or communications firm as a result of the combined offering of data processing and message switching (i.e. savings external to the communicator cum processor).

A firm today which wishes to implement a complete communications and processing system for its many branches may well find itself dealing with three separate firms - a communications utility, a hardware manufacturer and software development compny. If a company which needed a complete information system could deal with one rather than three separate firms, savings in negotiations, in clerical time spent in the accounting and payments functions would occur. In the following paragraphs we attempt to show that there are several configurations and relationships among suppliers other than which will yield the same economies to the customers as the case where the communications firm itself offers the data processing service.

Consortium or Joint Venture

As an alternative to the communications firm, offering of a complete package of communications hardware and software, consortia or joint ventures could be established among existing communications firms, hardware suppliers and software merchants

to develop special systems for large users. Such consortia could offer the savings advantages of the reduction in transactions costs which eminate from dealing with a single firm. Such joint ventures would allow the development of a group with sufficient size, skill and flexibility to meet the demands of any larger user. The question of responsibility and integrity could be met as it is met in other industries by designating one of the three component members of the venture as the prime contractor (not necessarily the communications firm). We feel that this idea is an appealing one, since it would increase the information flows and working ties between companies who could act together. The joint venture idea would allow the communications firm to be involved in the new developments in teleprocessing, allowing the communications utility to shape the environment so that it can best fulfill its diverse functions without necessarily involving the communications firm directly in the offering of data processing or software services.

Communications Firm as Broker

While the special venture approach is a useful way of meeting the needs of large users while minimizing transactions costs for such users, the small user is obviously not in a position to afford such special services. Having the communications firm act as a general broker for diverse software packages while maintaining their availability on a number of hardware systems would assist greatly both the small user and the small software purveyor. The idea of the communications

utility as the Sears-Roebuck of software is at first glance a most promising idea, however, the nature of the communications utility as a regulated monopoly unlike the standard mail order house requires strict regulation to ensure that unfair business practices do not arise. The software mail order house would have to agree to catalogue and to sell with equal effort, all software packages which meet certain minimal standards since there is no competitor to the software Sears-Roebuck. Naturally, the standard mail order house does not have to stock all the goods available since there are competitors available to the mail order house. The potential user of this software order house (any telephone user) would have complete information on all software available for certain tasks. The software Sears-Roebuck firm (Bell Canada) would offer real savings to both the independent software merchant and user since it could undertake individual billing, a task at which it excels. This concept would require examination in depth before implementation since there are many factors which tie users to certain purveyors of computing services.

SUMMARY AND CONCLUSIONS

It has been concluded from this study that there may be economies of integration in allowing communications firms to offer data processing services, but any economies which do exist appear to be quite small.

In the technical area small economies might result by minimizing communications costs and by slightly improving hardware utilization; however, the indications are that these will not have a large affect.

It is not obvious either that the existing sales, maintenance or management staffs of carriers have the excess capacity or necessary skills to handle the new venture of selling computing power and applications outside the firm.

Given that the interface between communications and processing is well defined, that the carriers have significant internal processing departments, and that the addition of data processing units to sell outside the firm would not alter the scale of the carrier significantly, we can see no advantages of integration in the research and development acitivity.

The literature in the field of finance has been cited to suggest that there are few economies of large size or integration in the cost of capital. The recent 50% decline in the share value of Micro Systems International (a Bell Canada Subsidiary) also suggests

that investors are interested in the marginal cost of capital, the riskiness of the new venture's earning stream, and not in the parent's average riskiness.

It was shown that although integration yields economies external to the firm, savings of transaction costs to the user, there are several alternative configurations of existing communications firms, hardware suppliers and software developers which can offer both the large and the small user these same savings of integration.

Finally, the integration discussed in this paper consisted of the new venture becoming an operating division of the carrier, sharing equipment, manpower and financing. If there are negligible economies in this type of close knit integration, the economies of integration between a carrier and a separately managed, separately financed, arms length subsidiary are nil.

REFERENCES

1. S.H. Archer and L.G. Faerber, "Firm Size and the Cost of Externally Secured Equity Capital", Journal of Finance.

2. D.C. Shaw, "The Allocation Efficiency of Canada's Market for New Equity Issues", Canadian Journal of Economics, II, No. 4, November, 1969, 546-556.

3. E.F. Fama, "Risk, Return, and Equilibrium", Report 6831, University of Chicago, Graduate School of Business, 1968.

4. W.F. Sharpe, "Capital Asset Prices: A theory of Market Equilibrium under Conditions of Risk", Journal of Finance (September, 1964), 435-442.

5. M. Miller and F. Modigliani, "Dividend Policy, Growth and the Valuation of Shares", Journal of Business, Vol. XXXIV, No. 4, (October, 1961), 411-433.

6. ______________________, "Some Estimates of the Cost of Capital to the Electric Utility Industry, 1954-57", American Economic Review, 56, (June, 1966), 333-391.

7. ______________________, "The Cost of Capital, Corporation Finance, and the Theory of Investment", American Economic Review, Vol. XLVIII, No. 3 (June, 1958), 261-297.

8. R.L. Johnson, "Financing Problems of Closely Held Corporations", State University of South Dakota, Business Research Bureau, Bulletin No. 73, 1961.

9. J.A. Schumpeter, Capitalism, Socialism and Democracy.

10. D. Hainberg, "Size of Firm, Oligopoly and Research: The Evidence", Canadian Journal of Economics and Political Science, February, 1964.

11. E. Mansfield, "Size of Firm, Market Structure and Innovation", Journal of Political Economy, December, 1963.

12. F.M. Scherer, "Firm Size, Market Structure, Opportunity and the Output of Patented Inventions".

13. R.N. Nelson, "The Simple Economics of Barren Scientific Research" Journal of Political Economy, June, 1959.

14. H.G. Grabowski, "The Determinants of Industrial Research and Development: A Study for the Chemical Drug and Petroleum Industries", Journal of Political Economy, March, 1968.

15. D.C. Mueller, "The Firm Decision Process: An Econometric Investigation", Quarterly Journal of Economics, February, 1967.

16. Department of Communications, Communications Canada.

17. J. Martin, Telecommunications and the Computer: Prentice Hall.

18. J. Martin, Teleprocessing Network Organization: Prentice Hall.

19. S.L. Mathison and P.M. Walker, Computing and Telecommunications: Issues in Public Policy: Prentice Hall.

20. President's Task Force in Communications Policy, Staff Paper I - A Survey of Telecommunications Technology, PB184412, Clearinghouse for Federal Scientific and Technical Information, U.S.A.

APPENDIX I

A Simple Model Illustrating the Cost Trade-off Between Economies of Scale and the Increased Probability of System Crashes

Assume that the communications firm wishes to offer data processing services on its message switching computer.

Let i be the number of messages moved through the telecommunications system per unit time. If we assume for simplicity, that each message is of the same length, then i*, the number of minutes of computer time used per message, can be determined. The total cost, C_t, of the telecommunications system can be written as -

$$C_t(p,i^*) = \alpha+f(i)+p(i^*)r$$

where α is the fixed cost (computers)

$f(i)$ is the variable cost $f(i)>0$

$p(i^*)$ is the probability of systems failure per unit time at usage rate i^* $p(i^*)>0$

and r is the cost of a systems failure including both out of pocket costs and goodwill costs.

We assume that the probability of failure increases with increased usage. The expression $p(i^*)r$ is the expected cost of a failure at usage level i*.

Suppose we allowed data processing as well as telecommunications and assume that the probability of a failure does not change. The introduction of data processing increases the usage rate of the computers per message to i** where $i^{**}>i^*$ for a given i. Therefore, the total cost at the new usage rate i** is

$$C_t(p,i^{**}) = \alpha+f(i)+p(i^{**})r$$

The average cost C_a per minute used is

$$C_a(p,i^*) = \frac{\alpha+f(i)+p(i^*)r}{i^*}$$

for usage rate i*, and

$$C_a(p,i^{**}) = \frac{\alpha+f(i)+p(i^{**})r}{i^{**}}$$

for usage rate i**

This means that

$$C_a(p,i^*) > C_a(p,i^{**})$$

since $C_t(p,i^*) = C_t(p,i^{**})$

and $i^{**} > i^*$

This analysis implies that economies of scale are generated from the excess capacity of the computer and that the variable costs are functions of the number of messages and not the time used in data processing per message.

We assumed that the data processing function will not alter the probability of a system failure. This is not the case. Adding the data processing function increases the probability of a systems failure at every given usage rate.

If we denote this increased probability of failure by q then,

$$q(i^{**}) > p(i^{**})$$

for all i**.

The probability increases since the telecommunication function requires a simple storage and forwarding of data, whereas data processing requires manipulation.

Therefore, the total cost which is a function of usage level and probability of failure is

$$C_t(q,i^{**}) = \alpha+f(i)+q(i^{**})r$$

and the average cost per message is

$$C_a(q,i^{**}) = \frac{\alpha+f(i)+q(i^{**})r}{i^{**}}$$

Since the cost per system crash has increased, i.e.

$$q(i^{**})r > p(i^{**})r$$

then $C_a(q,i^{**}) > C_a(p,i^{**})$

This means that apparent economies of scale caused by performing data processing tasks on messages on the same computer will be at least partially off-set and may be completely off-set by the increased cost of system failure.

APPENDIX 11

Transmission Costs

Rates for Multicom Service

Intercity

Half Group Service - 19.2 kilobits/second

Full Group Service - 40.8 kilobits/second or 50 kilobits/second

Minimum Monthly Charges

Transmission Rate (kilobits/sec.)	19.2	40.8	50
Flat Rate	$375.	$275.	$275.
Access Line	$250.	$300.	$300.

Transmission Charges (in 6 second increments, distances used are airline distances)

Transmission Rate (kilobits/sec) / Mileage	19.2	40.8	50
Up to 200	$.175	.35	.35
200 - 425	$.225	.45	.45
425 - 650	$.275	.55	.55
650 - 1000	$.325	.65	.65
1000 - 1400	$.375	.75	.75
1400 -	$.400	.80	.80

Cost of Communications Adapters

IBM 2701 $500.00/month - 2 needed

Cost of Direct Computer Connection

Central Processing Unit to Central Processing Unit	= $290.00/month
or	
Channel to Channel	= $290.00/month

Sample Calculation

Amount of data to be transmitted = 3×10^9 bits/month

Transmission Rate = 50 kilobits/second

Number of six second increments required

$$= \frac{3 \times 10^9}{50 \times 10^3 \times 6} = 10^4$$

Cost of transmission over a distance of 500 miles

$= 10^4 \times .55 =$ \$5500/month

Total Cost = Minimum Monthly Charges x 2

+ Transmission Cost

= 1150 + 5500

= \$6650.

APPENDIX III

Transmission Costs

Rates for Intracity Service

Monthly Charges for Short Distance Communication
(two or three city blocks)

$1,000.00 per month including modems.

Monthly Charges for Short Distance Communication[1]
(up to 20 miles)

Local Loop and Modems	= $1,100.00/month
Transmission Charges	= $ 100.00/month

A distance of 2 miles will be assumed in all calculations involving transmission charges.

1. These figures obtained from a conversation with Bell Canada, are only estimates of the costs, since accurate figures were not available. No price quotes for intracity communication at 50 kilobits per second have ever been requested.

<u>APPENDIX D</u>

COMMENTS

ON

APPENDIX C

THE ECONOMIES OF INTEGRATION

COMMUNICATIONS AND DATA-PROCESSING

(Dr. D. Cowan and Dr. L. Waverman)

by

Dr. John deMercado

February 5th, 1971

SUMMARY

This report deals with economies of integration associated with lumped computer-communication networks, and as such its findings are not applicable to distributed computer-communication networks.

The concept of a lumped (localized) computer-communication network, ie, one in which a computer is attached to a switching node in a telecommunication network, leads to considerations about reliability, redundancy, downtime, sharing and economies of integration, etc., which are completely different than those of a distributed network. In distributed networks, compatible computers are distributed geographically and in such a situation, redundancy, reliability, etc. cannot be identified in terms of parallel standby computers, but rather depends on switching properties of the network, and load versus time operation of the other computers in the network. The distributed approach is seen from some Carrier viewpoints, as the probable realization of their nation-wide computer-communication network. Thus this writer wishes to emphasize that the findings of the Cowan and Waverman study must not be applied to such cases.

This report is an excellent readable study of space-switched lumped computer-communication networks. Its finding are for the most part not relevant or applicable to analog and/or digital, space or time switched distributed computer-communication networks. Thus it does not really deal with the real questions of whether or not there will be economies of integration in a distributed network*) that is a probable ultimate realization of a national computer-communication network.

As far as the specific report is concerned, too much attention is devoted to the question of whether or not (ESS) computer-controlled cross bar switching systems could perform as computer processors. The well known conclusion, is of course that they cannot, in any real sense of the word. Furthermore, less than 8% of the switching in the Bell Area is ESS and outside of the Bell Area there is almost no ESS switching. It appears that what the authors are saying is that if telephone companies adopt ESS switching facilities in their analog network, then such a network could not in any stretch of the imagination be thought of as a realization of the computer utility. This is of course another reinforcement of the widely advanced argument that the telephone network which is optimized for voice traffic is not capable of meeting the heavy loading demands that a nation-wide computer utility could make of it, and that a "separate" dedicated network would be required. Thus, it would have been appropriate if the authors had gone on to a detailed discussion of the economies of integration in store and forward distributed computer-communication networks, that were separate (or integrated with) the existing networks. For example, they could have

---

*) This writer is not saying that there are economies of integration in distributed networks, only that the Cowan & Waverman's arguments cannot be used to resolve the question one way or another.

examined what sort of economies of integration were involved if the Carriers were to adopt the IMP (of ARPA fame) to realize a distributed network.

The authors touch lightly on message switched (or store and forward) networks, but neglect to discuss the real questions such as, how much hardware? versus how much software?, and the relevance of various types of errors, such as channel errors, system errors, and signal processing errors, and their effect on the reliability and performance of such networks. The case for multiplexor-concentration could have been stated in a more quantative terms, as is done for example in the papers of Rudin*).

There are a number of specific statements that the authors make that this writer cannot understand, for example on page 9, the statement that "the input to the system has no effect on its reliability" should be qualified. It is not true for time switched systems where source errors can play havoc with switching. In addition even in analog systems it is well known that by "tampering" in a certain way with tones in the signal, "free" long distance calls can be made, etc.

In addition their discussion of reliability criteria has to be qualified. Catastrophic failures have different significance in lumped networks then they do in distributed networks; the authors make no reference to the latter. In addition while their reliability analysis of parallel standby in a lumped system is straightforward, it only confirms that the obvious namely, that without standby redundancy, the reliability of a lumped system leaves a lot to be desired.

---

*) H.R. Rudin, Jr. "Data Transmission - A Direction For Its Future Development" IEEE Spectrum, Vol. 7 February 1970

H.R. Rudin, Jr. "Performance of Simple Multiplexer Concentrators For Data Communication" IBM Systems Architecture Research Labs, Zurich. Report RZ 347, Feb. 16, 1970.

However, their discussion is virtually meaningless in the context of distributed networks,because in distributed networks there is a tremendous amount of redundancy which cannot be identified in terms of standby computers.

This writer agrees with the authors, that it does not matter as far as economies of integration in lumped networks are concerned, whether a Carrier or some other party placed a computer next to a switching centre. However, he wishes to emphasize again that this conclusion in the distributed case does not follow from the authors arguments; and feels that the authors should have examined this result in the context of distributed networks.

Again, on page 15, the writer cannot understand the statement that in a message switching system, computer costs are small compared to overall system costs. This is difficult to reconcile with the fact that in the relatively simple telephone system, more than 40% of the costs are switching. The authors also agree with this figure (on page 31 of their report).

Their statement on page 15 that as "the number of computers in a message switched (store and forward) system increases, there may be fewer and fewer standby computers", is true, and is related to the reliability and distributed redundancy considerations outlined earlier. At this point the authors could have profitably pursued this idea further and modified their reliability analysis accordingly. Had they done this, they would have come to the real problem, namely, "are there really economies of single ownerships and integration to be achieved in distributed computer-communication networks, and conversely does a split of ownership of computer and communication hardware and software make economic sense in terms of reliability, maintain ability and flexibility of service offerings".

Finally, in this writer's opinion, Appendix I on page 55 lends nothing to the otherwise generally high quality of the report. The conclusion that "apparent economies of scale caused by performing data processing tasks on messages on the same computer will be at least partially off-set and may be completely off-set by the increased cost of system failure", is not proved by their model which virtually assumes this to begin with. It seems that one corollary of this statement, is that large general purpose computers do not make "economic" sense, or that special purpose computers should take preference as far as achieving economies of scale in lumped networks is concerned.*).

A more general and different argument has to be used to examine the trade-off's between economies of integration and probability of failure (reliability), before the conclusions of Appendix I, could be established one way or another. One possible approach (used by him in a different context) is presented by Howard**).

---

*) The writer <u>suspects</u> that in a "properly designed" distributed network, this statement might be true.

**) R.A. Howard - Dynamic Programming & Markov Processes MIT Press 1960. In particular, Chapters 6 and 7.

APPENDIX E

The Canadian Computer/Communications
Task Force

In a public announcement (copy attached) dated November 27th, 1970 Communications Minister Eric Kierans announced the establishment of a major task force designed to develop and recommend specific policies and institutions that can ensure the orderly, rational and efficient growth of combined computer/communications systems in the public interest. The Task Force is organized as an Activity Center within the Policy, Plans and Programs Branch of the Department of Communications according to the organization chart shown in Figure D-1.

There are five main sections in this organization:

1. <u>The Task Force Proper</u>

This consists of full time personnel housed in office space to be supplied by the DOC at 100 Metcalfe Street. The members of the Task Force will be a mixture of contract personnel drawn from universities and industry, and government officials, seconded from their regular departments for the duration of the program.

2. <u>The Professional Advisory Committee</u>

In order to ensure widespread public involvement in the Task Force work, the various non-government interested parties, e.g. the carriers, independent data-processing companies, Electronic Industries Association, Canadian Business Equipment Manufacturers Association, Consumers Council, etc., will be encouraged to set up their own independent study groups. These groups will work in parallel with the Task Force and will channel their ideas and comments to and from it via a Professional Advisory Committee made up of the chairmen of each of these independent groups.

3. <u>Interdepartmental Advisory Committee</u>

This body will contain representatives nominated by all of the Federal Government departments having an interest in the work of the Task Force and will provide a forum for transfer of ideas and comments between these departments and the Task Force.

4. <u>Executive Committee</u>

This committee will consist of the Task Force Director and senior officials of the Department of Communications and will provide a forum for management review of the work of the Task Force.

. . . 2

5. Provincial Advisory Committee

The work of the Task Force is of direct concern to Provincial Governments for a number of important reasons:

1. Many telecommunications carriers are provincially chartered and some are owned by Provincial Governments;

2. Some provincial carriers have expressed a desire to enter the data-processing business and, in at least one case, Quebec Telephone, public data-processing services are currently being offered;

3. The construction and operation of national computer/communications systems networks are likely to involve the direct participation of provincial carriers and provincially chartered data-processing organizations;

4. Provincial Governments or their agencies may be involved in the provision of certain computer utility services e.g. educational networks, certain data banks, provincial police and hospital networks, etc.

These factors have been recognized in the organization of the Task Force, where a special Provincial Advisory Committee will be formed to provide a convenient mechanism for transfer of ideas and comments between the Provincial Governments and the Task Force.

Objectives

The major program objectives include:

-- the analysis and forecast of national needs for computer/communications services;

-- technological forecasts and analysis;

-- the analysis of sociological and economic impact;

-- the evaluation of possible Institutional Arrangements for the Agency;

-- conceptual designs for, and cost/benefit analysis of, possible specialized networks; i.e., legal, financial, medical, S.T.I., resource, industry, consumer, raw computer power, etc.;

-- conduct of certain critical experiments with small scale pilot systems;

-- legal, constitutional and regulatory analysis;

-- description of the required Research and Development;

-- determining the required Government actions;

-- recommending a final Implementation Plan which will contain:

1) Description of and cost benefit analysis for a number of possible national networks.

2) Description of and justification for recommended institutional arrangements for the Agency including:

   - Roles and responsibilities of all parties
   - Administrative structure
   - Agency organization
   - Agency financial requirements
   - Required legislative actions

3) Recommended implementation schedule

4) Manpower requirements

5) Technical/Sociological/Economic impact evaluation

6) Recommended government policies and actions.

Figure D-2 illustrates the relationship among the many project tasks involved in achieving these objectives.

CANADA

DEPARTMENT OF COMMUNICATIONS
MINISTÈRE DES COMMUNICATIONS

TASK FORCE ON COMPUTER/COMMUNICATIONS.

OTTAWA, November 27, 1970. -- Communications Minister Eric Kierans today announced the establishment of a task force designed to investigate the whole question of computer/communications interaction in Canada.

The chief task assigned the Group, the Minister said, was to speedily develop and recommend specific policies and institutions that will ensure the orderly, rational and efficient growth of combined computer/communications systems in the public interest. The Task Force will be expected to produce definite recommendations and firm plans -- technical, financial and institutional -- relating to an integrated network of Canadian computer utilities.

The merging of computers and communications systems, Mr. Kierans said, had given rise to a new industry, called the computer utility, which could become one of the most important elements of our economy within the next ten years or so.

If the promise of the computer utility is fulfilled, he continued, the general public may have as ready access to data-processing systems as they now have to telephony.

The impact that this development could have on social, economic and political institutions and habits make it a focal point in any system of concerns about the quality of Canadian life, he said.

It was therefore essential that policies and programs in Canada should favor Canadian control without excluding essential contributions of outside expertise and capital; and, he concluded, to achieve this the Government of Canada must establish a suitable system of priorities and provide the framework of institutions or policies in which systems may develop.

Amongst those present at the press conference, was Mr. Douglas F. Parkhill who, as assistant deputy minister, will be responsible for the Task Force on Computer/Communications. Possible objectives of a national system could include, he said: achieving the most rapid expansion of services and systems that is possible without unduly disturbing our ability to meet other urgent social priorities; ensuring the widest possible range of services to

. . . 2

all social and regional groups in every part of Canada; ensuring adequate Canadian control and ownership; ensuring that the overall system design is flexible enough in concept and implementation to minimize problems of obsolescence and permit the rapid incorporation of improvements resulting from technological change; ensuring adequate protection for privacy, right of access and freedom of speech in all elements of the national system.

A special group formed within the Task Force will prepare a separate report on the critical area of privacy.

The task force on computer/communications in Canada will be headed by Dr. Hans Jacob von Baeyer, former president of Acres Intertel Limited. Earlier Dr. von Baeyer served as consultant to the Science Secretariat's study of scientific and technical information in Canada and Federal Government studies of domestic communications facilities, data transmission and systems, with an emphasis on the comparison of terrestrial and satellite communications.

Mr. Jules G. Nadon will be Executive Secretary and Director of administration. Mr. Nadon joined the Public Service Commission in 1966 as Director, Administrative Manpower Recruitment and Development Program. He also served in Paris where he was Attaché (Personnel) at the Canadian Embassy.

The Task Force will recruit some 25 experts from government, industry and universities. A preliminary report is expected by May 1971.

Mr. Kierans stressed that the task force's objectives will require cooperation with industry, users and other governments. He outlined some of the steps in the task: an analysis of national needs; technological forecasting; a study of social and economic impact, and, a definition of possible institutional arrangements. The Group will bring cost-benefit analysis to bear on particular networks that might be able to provide such services as legal, financial, medical and consumer information as well as raw computer power.

In order to assure widespread public involvement, various non-governmental interested parties, the common carriers, Canadian civil liberties associations, data-processing companies, the Electronic Industries Association, the Consumer Council and others, will be encouraged to set up their own independent study groups. These groups will work in parallel with the task force and will channel their ideas and comments via a Professional Advisory Committee made up of the chairmen of each of these independent groups. The task force will also make extensive use of contracts to universities and industry for specific studies.

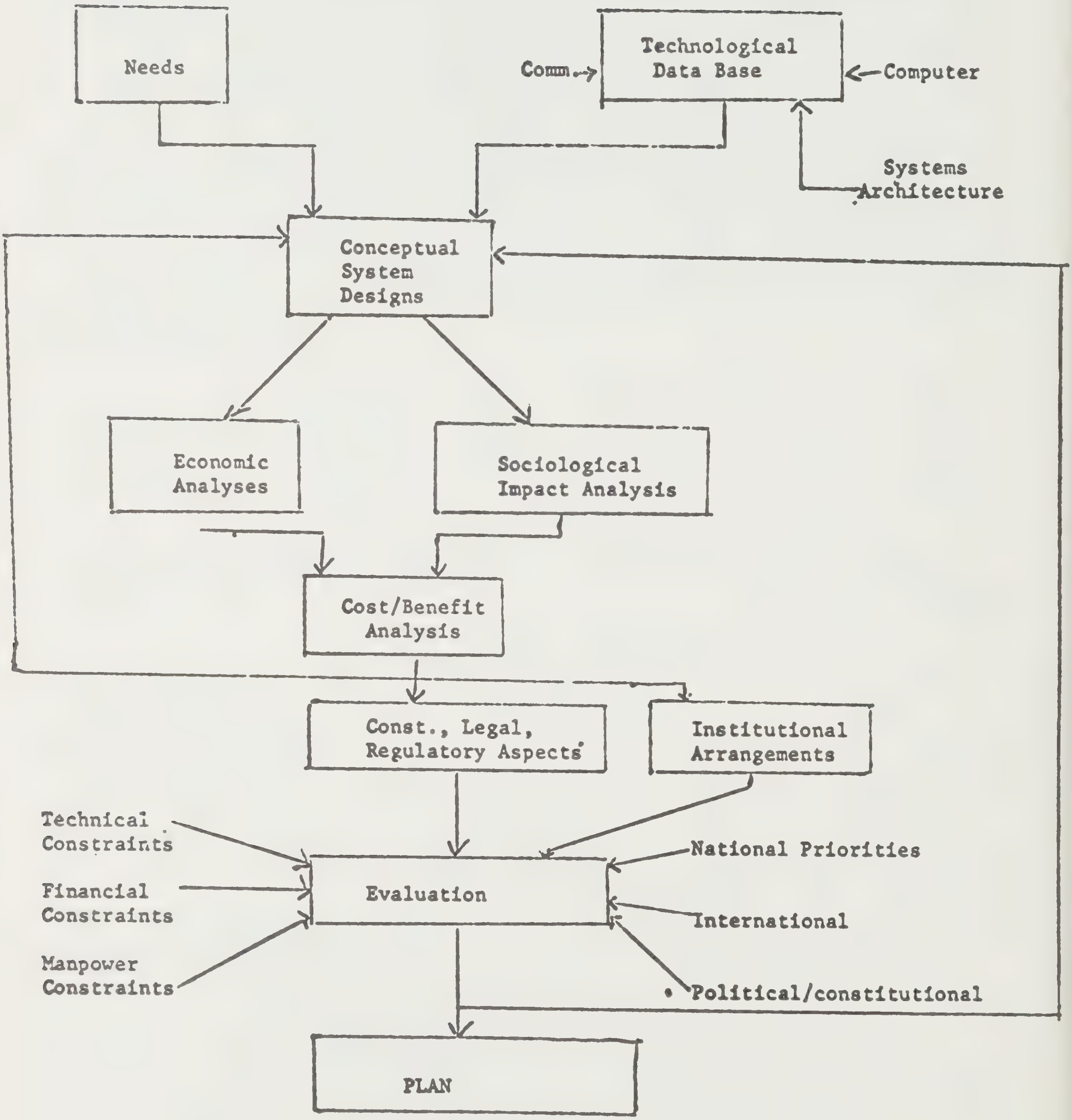
Active cooperation of the provinces has also been requested.

The accelerating rate of advance of many countries in the field of computer/communications systems makes it imperative, said Mr. Kierans, that positive and rapid action be taken if we do not want to find ourselves far behind other technologically advanced societies. Quoting from a Telecommission Report, the Directorate for Scientific Affairs of the O.E.C.D. asserted recently in Paris: "Out of this widespread availability of 'information power', there will flow social changes and opportunities for human development that promise to make the next few decades among the most critical that mankind has ever faced". So we must make sure, concluded Mr. Kierans that this technology will serve us and not the contrary.

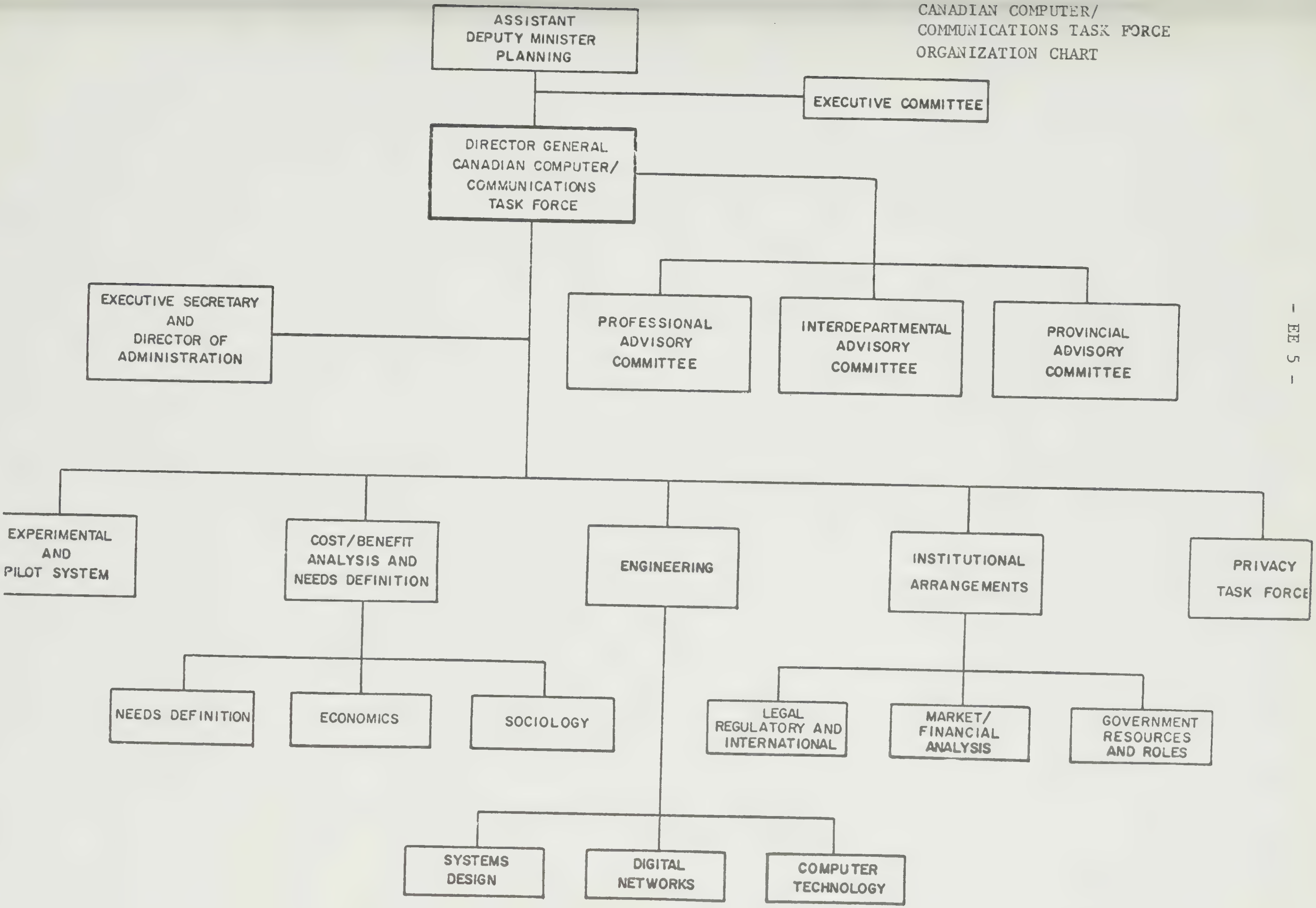
Information Services
995-8185

Figure 1

WORK FLOW



CANADIAN COMPUTER/
COMMUNICATIONS TASK FORCE
ORGANIZATION CHART



December 1, 1970

TELECOMMISSION

Study 5(b)

Conference Report – Computers: Privacy and Freedom of Information

The Department of Communications

Telecommission Study—(5b)

CONFERENCE ON

COMPUTERS: PRIVACY AND FREEDOM OF INFORMATION

Queen's University
May 21 - 24, 1970

Available by mail from Information Canada, Ottawa,
and at the following Information Canada bookshops:

HALIFAX
1735 Barrington Street

MONTREAL
1182 St. Catherine Street West

OTTAWA
171 Slater Street

TORONTO
221 Yonge Street

WINNIPEG
393 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

Price: $2.00 Catalogue No. Co41-1/5B

Price subject to change without notice

Information Canada
Ottawa, 1971

This is a Report on the Conference and does not necessarily represent the views of the Department or of the federal Government. No commitment for future action should be inferred from the recommendations of the participants.

This Report is to be considered as a background working paper and no effort has been made to edit it for uniformity of terminology with other studies.

"COMPUTERS: PRIVACY & FREEDOM OF INFORMATION"

PREFACE

The potential impact of computers upon individuals, their values and their rights, and in particular the relation of computerized information systems to personal privacy has become a matter of world-wide concern - as witnessed by the extended hearings in the United States Congress on a proposed National Data Bank, by resolution 1028 of the twenty-sixth session of the General Assembly of the United Nations on Human Rights and Scientific and Technological Developments, and by studies initiated in the United States, Britain, West Germany, Sweden and Denmark. In order to begin this same process in Canada, four groups undertook early in 1970 to sponsor a conference on this subject:

- the Department of Communications
- the Department of Justice
- the Canadian Information Processing Society
- Queen's University

This report summarizes the proceedings and discussions of that conference which was held at Queen's University, Kingston, Ontario, from May 21-24, 1970.

A conference committee and a program committee were appointed to plan the conference. In recognition of the dual importance of maintaining both privacy and freedom of access to information these committees selected as the title for the conference: "Computers: Privacy and Freedom of Information", and set as objectives:

"a) to discuss, examine and define the issues of personal privacy and right of access in the operation of information systems and data banks,

b) to identify the probable problem areas in the application of computer technology to data collection, storage and retrieval,

c) to suggest guidelines for the protection of privacy and of access to information in tomorrow's technology,

d) to record the informed opinions of a representative group of those concerned with the design, operation and use of computerized information systems and data banks on the issues of privacy and right of access."

Three key intentions governed the planning of the conference:

1) every attempt would be made to have a full range of views represented. This would be achieved by appropriate selection of the topics, the invited speakers and the invited participants;

2) every attempt would be made to go beyond the popular discussion of the theme and come to grips with specific problems and detailed proposals. This would be achieved by:
   - limiting conference attendance to participants who already were involved in the subject or who were likely to have some direct involvement in the near future;

- distributing advance review papers to participants, so that they could come prepared, and with some commonality of background;

- organizing multi-disciplinary workshop sessions among small groups of people, to provide ample opportunity for free discussion;

- ensuring that there would be adequate arrangements with respect to the distribution of materials and the recording of proceedings. These would include distribution of the written texts of speakers, summaries to be made by rapporteurs of the workshops, and a final report to be a coherent expression of the whole conference;

- documenting a number of proposals regarding computers and data banks, and recording measures of agreement or disagreement on these proposals;

3) every attempt would be made to set the theme in a Canadian setting. This would be achieved by:

- ensuring that the background texts included materials on Canadian laws and practices;

- keeping in mind the joint federal and provincial responsibilities in the selection of speakers, discussants and participants;

- providing for both French and English contribu-

tions in written materials, and simultaneous translation, in the discussion.

As recorded in the Introduction, the conference achieved a surprising measure of consensus both on the nature and extent of the problems in respect of privacy created by the rapid development of computerized information systems and on the scope of possible solutions to these problems. The formulation of specific solutions to these problems will depend upon the various studies recommended by the conference; their implementation would then be the responsibility of the governments and other institutions concerned.

The overall report of the conference was written by Mr. Ian Rodger of The Financial Post. In the view of the Program Committee, it faithfully records both the extent of the consensus which was achieved, and the measures of disagreement which were revealed. In addition, our thanks are due to Queen's University for the excellence of the arrangements which played so large a part in assuring the success of the conference.

R. J. Gwyn
Conference Chairman

C. C. Gotlieb
Chairman
Program Committee

INTRODUCTION

The holding of a conference to explore the effects of computer technology on personal privacy and freedom of information was, as Justice Minister John Turner pointed out, "of no small significance - and indeed of some historic value." Mr. Turner added, however:

> "It is not so much a matter of self-congratulation as perhaps for self criticism, for the problems posed to privacy and freedom of information by the new cybernetics of a technetronic age have been with us for some time. Indeed, the generic issue of the right to privacy - or the threatened invasions of privacy - has been part of the intellectual tradition and jurisprudential inquiry in the United States since 1890."

While it is true that Louis Brandeis, later Associate Chief Justice of the United States, co-authored a pioneering article in 1890 on a right to privacy, it was not until the 1960s that the issue really gained momentum, in the United States or elsewhere. To trace the reasons for either the general neglect of a right to privacy in the past or the sudden flowering of interest in it in recent years would be a formidable and perhaps unrewarding task. Like pollution, privacy is a 'problem' that has been thrust upon our consciousness.

The particular event that sparked the current concern about personal privacy and the computer was probably the 1965 proposal of the U.S. Social Science Research Council that the Bureau of the Budget establish a "national data center" to organize the efficient retrieval of information about citizens as a consequence of the government's involvement in the complex areas of poverty, health, urban renewal and education. The proposal was presented to a Congressional sub-committee and led to the now-

famous hearings in 1966 on "Computers and Privacy" under the chairmanship of Rep. Cornelius Gallagher. Public and political reaction to the proposal was immediate, vocal and almost wholly negative.

Since then, a wealth of legal articles, books, studies and legislative proposals has appeared.

In the United States a major study organized by the National Academy of Sciences will complete its inquiry by June 1971, and the Congress continues to struggle with this topic. In Britain, Parliament has established a Select Committee to study this issue. In France, the Conseil d'Etat was assigned the task, early in 1970 of studying juridical problems in the computing field, including the challenges computers pose to individual liberties. Sweden appointed a Royal Commission in 1966 to elaborate legislative proposals concerning the protection of privacy in general against invasion by modern scientific and technical devices. Denmark has a similar study in progress.

In the United States, two major books, Privacy and Freedom, by Alan F. Westin, a Columbia University professor, and The Death of Privacy, by Dr. Jerry Rosenberg appeared in 1967 and 1969 respectively. Professor Westin will shortly publish a second book, as will Professor Arthur Miller of the University of Michigan on privacy.

The Organization for Economic Cooperation and Development (OECD) and the United Nations have made the protection of privacy a major topic for study.

The British Columbia provincial government has enacted a right-of-privacy statute. A private-member's bill to circumscribe the activities of

"data banks" has been introduced in the Ontario legislature and an amendment to the Civil Code of Quebec has been proposed that would protect the privacy of an individual. A number of proposals were made by Professor Ed Ryan in his study <u>Protection of Privacy in Ontario</u>, undertaken on behalf of the Ontario Law Reform Commission.

In all this analysis and concern for the problem of privacy, one surprising fact emerges: privacy itself has never been objectively defined. It has been described many times, and everyone has a subjective version of what he considers his own privacy or personal property to be. One of the most succinct definitions, though not an all-encompassing one, was created by the 1964 Nordic Conference on the Right to Privacy: "The right to be let alone to live one's own life with the minimum degree of interference."

Professor Westin for example, considers privacy to be a basic human need related to the territorial imperative scientists have discovered in animals. In <u>Privacy and Freedom</u>, he writes: "What the animal studies demonstrate is that virtually all animals have need for the temporary individual seclusion or small-unit intimacy that constitute two of the core aspects of privacy." The extent to which privacy has been recognized and respected, however, has varied widely from one society to another. At one extreme, the Arabic language has no word for privacy; at the other appear to be Anglo-Saxon societies with their notion that a man's house is his castle.

Another train of thought, considering only Anglo-Saxon societies but in an historical perspective, leads to the unexpected conclusion that the average individual probably enjoys greater privacy today than ever before. Today most of us live alone or with only one or two other people,

in one or many huge, impersonal, urban complexes. Our grandparents mostly lived in small communities where anonymity and hence privacy were impossible; everyone knew all the sins of his neighbours.

Further, it must be pointed out that computers did not create the problem of privacy: Governments, commercial corporations, the police, maintained massive dossiers on individuals long before the digital computer arrived. What computers have done is to introduce several orders of magnitude of efficiency into the whole process of information gathering, manipulation and distribution.

As Communications Minister Eric Kierans put it in his keynote address to the Queen's conference:

> "This conference is a step, and no more than a step, in exploring the potential invasion and circumscription of privacy which may be brought about by the rapid development of computerized information systems and data banks. In this instance, there is a very clear potential social cost which must be matched against the quite obvious social and economic benefits of computerized data banks. It is precisely the kind of issue which we must explore and resolve if we are not to permit, without intending to or willing it, a wholesale technological pollution to match our industrial pollution - a technological pollution which could end up with us re-ordering our social behavior and priorities to suit the mechanical convenience of machines."

Taking part in the conference were some 150 businessmen, lawyers, computer scientists, economists, educators, sociologists and private citizens. Some participants apparently came convinced that there was no problem of computers and privacy at all and apparently hoped the conference would simply put the question to rest. A few suspected a plot - that the

conference was being held to justify the drafting of yet another batch of restrictive legislation that would put still more power in the hands of government officials. Still others appeared to be so eager to bring about sweeping, general legislation that they had not adequately considered damages that might result to the economic system and established institutions in the society.

This divergence of views suggests the conference planners had done their job well, that, as the conference Chairman put it: "The conference itself, to the extent that human frailty can do it, is representative of industry, of users, of interested individuals in the universities, in the legal profession and in government. It also, again within the limits of human frailty, is balanced between these different groups."(1)

Opening Thursday evening with a plenary panel session on "Privacy and Openness as Social and Legal Concepts" the conference proceeded through five more panel sessions interspersed with four meetings of workshop groups. The other panel topics were:

b) Data banks: existing technology and practice.

c) Data banks: direction of development resulting from needs and technology.

d) Objectives for securing privacy and freedom of information in data banks.

e) Legal and regulatory means of reaching objectives.

f) Professional and technical means of reaching objectives.

---

(1) For list of conference participants, see Appendix C. Some conference participants complained there were no representatives present from youth, from consumer groups or from the public at large.

For the workshop sessions, conference participants were divided into groups of 12 to 16 for a free discussion of issues raised during the panel sessions. Each workshop turned in a report of its views and recommendations on Saturday evening after the last workshop meeting. The conference secretariat then studied these reports and distilled from them a final summary report which was presented to the full conference in plenary session. Copies of the workshop reports were also then circulated among participants for verification. The approved text of the conference summary report is reproduced in Appendix A.

It was also explained at the plenary session that rather than produce a verbatim "Proceedings" of the conference, an edited summary report would be written and distributed to all participants. This report would attempt to capture all of the important, and much of the enjoyable, information and opinion that emerged in the position papers, the panel sessions, the question-and-answer periods that followed them and the workshop sessions.(1) And above all, it would attempt to put all this information into a coherent, readable form.

The following report is the result. Its format deviates somewhat from the chronological order of discussions at the conference, usually in order to bring together comments and discussion on what turned out to be recurring topics. In attempting to be comprehensive, the report may give the impression of wide disparities in the viewpoints of participants. Indeed, there were several major differences of opinion to be recorded. However, on most topics, a nascent consensus could be detected - either

(1) The list of position papers and background papers is contained in Appendix B. These documents are available, on request, from the Department of Communications.

through lack of argument or through an apparent synthesis arising from lengthy discussion. Most participants were truly astonished at the end of the conference to realize that such a wide area of consensus had been reached.

This report is divided into four chapters.

Chapter I deals with the problems of understanding privacy as a social and legal concept. Such an understanding is fundamental to any attempt to evaluate current practices that may invade privacy. It is even more important for those attempting to foresee future technological developments which may occasion even greater invasions of privacy. For example, it is well known that governments, school boards, doctors, police and several others carry out activities for various purposes and with various degrees of discretion which may result in invasions of individual privacy. But it is impossible to decide whether or not their practices are acceptable until a general notion of privacy is accepted. Furthermore, it is entirely possible that emerging technologies, when harnessed in the service of governments or doctors or others, may so change the nature of the activities of these groups as to make them become invasions of individual privacy. Again, a notion of privacy is a prerequisite to determining the rights and wrongs of this situation. The chapter concludes with a summary of the ways in which privacy has been acknowledged historically in the law.

Chapter II is about information. It brings together various notions about the power of information and the ways in which the development of "information systems" affects that power. For purposes of illustration, the operations of some information systems are described.

Some suggestions of ways in which information systems may be classified are also included in this chapter.

In Chapter III, the subject of the computer's impact on information systems is discussed in detail. Here are indications of the ways in which computers may alter information systems, for better and for worse, and also some discussion on the technical and economic feasibility of developing large-scale computer-based information systems.

Finally, in Chapter IV, the various proposals for action and the reasoning behind them are recorded.

CHAPTER I

PRIVACY: SOCIAL AND LEGAL CONCEPTS

"Privacy may be one of those things like beauty, truth and freedom - something that exists only in the eyes of the beholder." That remark, by Dr. Leon Katz, member of the Science Council of Canada and Professor of Physics at the University of Saskatchewan, seems to sum up the many frustrating attemps by conference delegates to come to terms with the notion of privacy. The subject of privacy as a social and legal concept was treated in depth by the conference's first panel but apparently not fully enough, for it surfaced again and again in workshop sessions and in post-panel question periods as delegates tried to come to terms with it. Many declared there was no point in talking about anything else until the issue was settled. The conference summary report does no more than list some of the major trends of thought:

> "Several workshops referred to the necessity of elucidating the notion of privacy as a legal concept or, indeed, to elaborate on a philosophy of privacy. Some doubted that this could be done except on an ad-hoc basis and others felt the concept varied with historical or social circumstances and should be left to the courts. Again, others reached the conclusion that the right to privacy should be expressed in the law and that it should be in accordance with the Universal Declaration of Human Rights."(1)

With the advantage of retrospect, one can detect from the many papers and discussions on this topic that attempting to define privacy may have been the wrong way to approach the problem. Rather, starting from the premise that privacy, whatever it may be and however it may be defined, is vital to and perhaps synonymous with an individual's sense of dignity, the problem is to find out exactly what actions offend an individual's or a

(1) See Appendix A for conference summary report.

group's or a country's dignity and then to do something about them. First, however, let us test the premise - that privacy is vital to an individual's sense of dignity.

1. Privacy and Dignity

> "We as an advanced society have always been invading privacy. We have always forced the poor, we've always forced the young, unwed mothers to bare their souls but it's only lately that the middle-class society has become concerned about privacy because it is their society that now stands a risk of being invaded."
>
> - Thomas L. McPhail, Loyola University.

One of the most striking examples of how the quality, indeed the nature. of a man's life can be altered by invasions of privacy, was given by Ontario M.P.P. Tim Reid, panellist and author of a private member's bill concerning data banks and privacy which he introduced into the Ontario Legislature in 1969. The example had to do with information collected and used, concerning high school students.

Reid pointed out that high school students, aware that comprehensive reports are prepared about them by teachers and school authorities, are under tremendous pressure to conform.(1) He described the case of a student leader to whom he sent a personal letter in care of the school principal's office. The student received the letter after it had been opened by school authorites. His dilemma: "If I make a fuss, someone will put on my record that I'm unreliable, a troublemaker." Reid then

(1) Prof. J. M. Carroll of the University of Western Ontario described the Ontario student record form. "It invades privacy to a greater extent", he said, "than do the records filled out by a convicted criminal being placed on probation, an individual taking a high security position with the Federal government or a recipient of welfare. It includes things like language spoken in the home, religion, occupation of parents, where the student does his work, how much homework he does, whether he has his own desk and numerous other items of personal information."

expanded this example to the larger society.

> "The student who knows information is being collected about him and who is concerned about having a good record so he can get into university and get a good job is just like the family man who finds out the kinds of information now being collected by investigative agencies. People are just beginning to understand how much is collected and they tend to react in one of two ways. They will fight if they can't be hurt. More often, they will say to themselves that it is better to wait for ten years until their children are grown up. (The period during which the family needs a good "credit-rating". In the meantime, they conform and opt-out of the fight to protect such pernicious invasions of their privacy.

Justice Minister John Turner, in answer to a question, distilled the essence of this point. "The right to dissent", he said "becomes a very difficult right to maintain if there aren't those areas in which one can discuss without the fear of being overheard. A democratic policy depends on a lot of confidential relationships, conversations, the ability to muster support in private, and so on."

Another example of how awareness of surveillance can affect an individual's behavior was given by Claude-Armand Sheppard, a Montreal lawyer and panellist at the 'Concept-of-Privacy' session. He described a hypothetical case of a married man who, unknown to his wife, frequents a bar popular among homosexuals. The man is, of course, aware that police often raid bars such as this one and that they probably note his presence there. If this man were charged with an offense totally unrelated to the fact that he sometimes went to that particular bar, asked Sheppard, would he not be reluctant to mount a strong defence for fear that the police might bring forward their knowledge of his activities in the bar and thus embarrass him

in front of his wife and family.

It was this kind of individual reaction to surveillance that A. E. Gotlieb, Deputy Minister of Communications, undoubtedly had in mind when he remarked:

> "The individual may come to feel to an ever-increasing extent that he is spied-on in an information-dominated society, and his behavior may be influenced to the point where he prefers to act in the same way as those around him and not set himself apart."

The result, according to Gotlieb, "would be an atrophied society whose members would show no initiative or willingness to innovate."

Surveillance, when it succeeds in recording information that an individual considers private, demeans that person's dignity. And the preservation of individual's sense of dignity, according to Justice Minister Turner, is of crucial importance to a democratic society:

> "The erosion of privacy is the beginning of the end of freedom. For privacy is the foundation of the principle of autonomy, at the core of human dignity. The right to privacy not only goes to the core of our being as individuals but also the core of our being as a society or state. A state that demeans its individuals demeans itself. A society that mocks the privacy of individuals mocks itself."

It is extremely difficult, however, to nail down just what people consider to be private and personal; to know which invasions will upset an individual's sense of dignity and which ones will pass unnoticed. An even when and if these unacceptable invasions can be discovered, there is the equally difficult legal problem of sanctioning their occurrence.

> "Congestion is the only thing that will save privacy. Today, the most private place one can be is in his car in the midst of a traffic jam."
>
> - Gordon Thompson, Bell Canada-Northern Electric Research Ltd.

2. Notions of Privacy

The simple act of asking what privacy means is a powerful indicator that a significant change in people's understanding of that notion has, and is probably still, taking place. In other words, people ask the question because they see around them evidence that activities they once considered private are, in fact, no longer private and/or things they once considered public have become private. Examples are easy to come by. One conference participant said that when he was young, his father wouldn't tell anyone how much money he earned. Now that information is public. On the other side, aspects of community living which were once shared among neighbours have now become private. How many people in high-rise apartment buildings have more than a passing acquaintance, if that, with their neighbours?

R. F. Linden, a computer specialist with the Federal Department of Industry, Trade and Commerce, claimed that the concept of privacy varies not only with time and between generations, but also between nations, between regions and between social groups. He said that in Germany, for example, people are appalled at the size and scope of North American credit information systems, considering that these wreak gross invasions of individual privacy. But they do not mind, as we probably would, reporting to the police each time they change residence. The Dutch, Linden continued, won't have social security numbers or their equivalent for at least three generations. The

reason: when Holland was occupied during the Second World War, the German Gestapo issued each citizen a number. And so, for the Dutch, social security numbers have come to be seen as a threat to the individual. The Danes accept that their government maintains a complete dossier on each citizen but they refuse to allow these dossiers to be computerized. Apparently, during the war, when the Danes wanted to hide someone, they could secure their efforts by stealing the individual's dossier. If the dossier were on a computer, that would be very difficult.

The common thread in each of these examples is the individual at a given moment of time confronted by a situation which may compromise his sense of dignity, indeed, his security through an intrusion into an area he considers to be private. The important point is that this evaluation takes place in the mind of the beholder. It is completely subjective. As the mind's sensitivities evolve under the influence of time, experience and culture, so the individual's evaluation of what is private and personal evolves. Privacy appears, above all, to be a dynamic concept, one that defies definition, except in terms which are also dynamic.

3. Measures of Privacy

If privacy is a dynamic concept, a major problem is to discover what it means to any given social group at any given time. For only when there is an awareness of consensus in a society about what is to be considered private can that society take legal action against those who infringe upon an individual's privacy. There emerged from the conference papers and discussions several suggestions of ways of measuring a group's beliefs about privacy. All appear to be based on a tension that exists in

each situation in which privacy is in play - a tension between those who would keep information private and those who would have it shared to a greater or lesser degree. Apparently, there is an immense variety of types of situations in which this battle between privacy and openness takes place, and undoubtedly several ways of categorizing these types.

The conference seemed to focus on two main groups:

a) those in which the individual wishes to keep certain personal information to himself while an outside agency, private or public, attempts to record it for any of various purposes.

b) Those in which the individual wishes to have access to information that governments or private information collection agencies would rather withhold.

In many situations, of course, both these struggles may occur at once. For example, a credit bureau may seek out and record information about a person that the person might not willingly have revealed. Then, the agency may well refuse to allow the individual to review the recorded information. And in almost all cases, it appears that the individual is pitted against large, powerful institutions within the society, such as government agencies, research establishments or corporations. And reconciling the rights and legitimate interests of the two sides is not an easy task.

Professor Thomas McPhail, a sociologist at Loyola University, Montreal, and a panellist at the session on securing privacy in data banks, posed the dilemma of the social scientists as a prime example:

> "Social scientists do definitely invade privacy. There is no doubt about it. All you have to do is refer to the classic Kinsey studies or the contemporary Johnson & Masters studies which are recorded in two books, <u>Human Sexual Response</u> and <u>Sex Behavior in the Human Animal</u>.

> As a social scientist, I am very much concerned with the definite need for Canadian legislation to protect individuals from the ruthless and undemocratic invasions of privacy by government, military or private and public agencies with little regard for human dignity or due process; but as a social scientist I am concerned also that in an overzealous attempt to protect everyone from everything that social science research may be brought to a standstill in many vital areas . . . The right to collect data, particularly in sensitive areas; for example, family, religion, income, illegitimacy, education, alcoholism, divorce, abortion, etc. is essential for some social science research."

Similar views were expressed by government planners, statisticians and businessmen involved in market research. Their argument is that they collect information only to detect social tendencies and trends and that they have no interest in relating particular information to identifiable persons. They promise not only to protect the individual's dignity but also to conduct research that will benefit the individual in one way or another.

While these arguments are impressive, they appear to have been advanced after the event. In other words, the planners, statisticians and others in this group appear not to have considered whether or not people like being the objects of research. Instead, having decided that their functions are important and legitimate, they have performed them without much thought given to the legitimacy of conflicting claims. As M.T.Pearson, general manager, Associated Credit Bureaus of Canada, said at one point, "No one ever asks the consumer what he thinks." For the purposes of measuring a social group's feelings about privacy in situations like these, it would appear essential to find out how far the individuals in that group are willing to allow various agencies to probe, even if anonymously and even if for the benefit of these individuals either singly or collectively. At what point, for example, do

these persons decide it is in their own good to keep information to themselves?

A. E. Gotlieb of the Department of Communications conceptualized the meaning of this decision by the individual as "the right to disconnect, or in other words, the right not to communicate." One of the fundamental principles of our society, he said:

> "is respect for freedom of the individual, a freedom that can express itself in a choice between communicating and not communicating. Every man should be free not to avail himself of information. But this is only one implication of the right not to communicate. It must also involve the right not to communicate involuntarily, that is, the right of the individual to restrict the use of information that has been gathered about him."

Another group of data collectors, led by credit and personnel agencies, only partially conceals the identity of the individual. But their justification is that their information systems are vital for the efficient operation of the economic system. Pearson claimed in his position paper that "Canadians enjoy a better standard of living than ever before because we are a credit-oriented society." And, he adds, "Without credit bureaus, it is reasonable to assume that individual business firms would be reluctant to grant credit without a long and costly search; many deserving persons, particularly average wage earners, would be refused credit because of insufficient data; and delays in obtaining credit would result in the loss of sales and decline of business volume." While this is undoubtedly correct, again it appears likely that individuals have not been asked their opinions. And the key question would be: At what point does a person feel the efficient operation of the economic system compromises his dignity? How much efficiency is he willing or even eager to

foresake in return for being probed less intensively?

Still other groups of data collectors, such as doctors, lawyers, police agencies, etc. each want personal data for different reasons and use it with varying degrees of discretion. In each case, the individual is presented with a challenge. Does he accept willingly that these agencies collect and use information about him or does he feel compromised by its disclosure in any way? Apparently, no one knows and no one has given much thought to the problem of finding out. But the answers are obviously vital for they become the measure of a person's expressed need for privacy to maintain his sense of dignity.

The other category of privacy-openness confrontations is manifested in situations in which the individual desires to have access to information that others would rather withhold. Again, A. E. Gotlieb, in his paper, conceptualized this desire as:

> "the right to communicate, or, in effect, the right to be connected. In a society dominated by information which is what we are moving towards, no individual should be required to remain apart from the automated flow of information. The disadvantages would be too great, and the gap created for the individual could become impossible for him to span by other means."

Today, this desire is most frequently articulated - and it was at the conference - as that of the individual to have access to information held by governments. Governments generally have a tendency to withhold information about their activities even when there is no reasonable justification for doing so. As Justice Minister John Turner, put it, "This is the tendency of governments to abuse citizen entitlements under the guise of privacy. In other words, government secrecy is sometimes legitimated as the need for a

government's right to privacy but which may well be a denial of the public right to know."[1]

The belief that there are abuses in this area was almost universal. Ten of the workshops agreed on the need for protection of freedom of access to information. And the conference summary report states: "this was regarded as being particularly important with respect to government information." Many conference participants believe this right of access to information should extend to other domains as well - notably to permit individuals to inspect credit and other personal information files and to obtain redress for inaccuracies. Others would go further, still others not as far. But there was general recognition of a danger that institutions can exploit privileged information to the detriment of individuals.

This danger develops from the concept of information as power, the idea that the exclusive possession of certain kinds of information confers upon the holder certain power. The overt use of compromising information about an individual to blackmail him is a simple example. Others, both more subtle and more frightening in their potential consequences, were cited at the beginning of this chapter. A related danger, to paraphrase Allan Gotlieb, is the widening gap between the few who collect and manipulate information and the many who are manipulated, particularly if they are aware they are or can be manipulated.[2] Enlarged, this gap could result in a paranoid, intellectually atrophied society. And, with the rise of sophisticated, electronic techniques for gathering, storing and securing information, the prospect of this

---

(1) "Paradoxically, an increase in government's privacy compromises individual privacy. Conversely, by stripping government and other institutions of their privacy, the individual's privacy zone grows."
- Hugh Lawford, Queen's University

(2) See page 16.

gap widening appears to many to be a very real one. Hugh Lawford, professor of Law, Queen's University, described one of the many ways in which computers can widen the gap.

> Clearly, it is conceivable to create an information system under government control which permits only authorized officials to view only documents which they are authorized to see. Since the computer system can use transitory displays of information upon television screens in officials' offices, there need not be any unnecessary copies of documents. Since the system can record the name of every official who has viewed a document, responsibility for the unauthorized disclosure of government information can more readily be traced back to the particular official. A single system may serve a whole government department (and possibly even a whole government) through one centralized collection of machine-readable files. These central files do not require the intervention of a host of human file clerks, messengers, librarians and the like, and the internal government community responsible for custody of information can be shrunk to an extremely small group.

These two dangers - that institutions have sensitive personal information with which they can manipulate individuals and that this information may be concentrated in fewer and fewer hands - can be reduced in at least two ways. One is to force the would-be manipulators to make their information universally available, thereby stripping them of their potential power to blackmail or intimidate individuals. Another is to forbid the would-be manipulators from collecting information in the first place.

In some situations, of course, perhaps for reasons of national security, information must be gathered and must be withheld from the public. But Justice Minister Turner was the first to admit that these situations are few in number and widely accepted by the public. There may also be other

situations in which the public would prefer that information collections be kept secret; still others where the public wants the information kept confidential but claims a right to review its accuracy. In still other situations, perhaps the public doesn't care. But once again, no one seems to know what the public thinks or wants.

At this point, one is tempted to suggest that information collection agencies should stop whatever they are doing and run out and conduct a series of public opinion surveys. In so doing, they would find out how much information people will divulge and to what extent people want access to information held by others. Certainly, such a move would be a step in the right direction but it is fraught with dangers. One of the few initiatives in this direction was a research project undertaken by the Associated Credit Bureaus of Canada in 1968. One of the conclusions of this work, as reported by M. T. Pearson, general manager of the ACBA, was that "the public has a low level of awareness of the credit bureau function and an almost infinitesimal interest in the process of credit reporting."

Without wishing to impugn the efforts of the ACBA, this example points out a serious problem that will arise in any attempt to sound out public feelings on subjects such as this. In any such sounding, one could seek to discover what levels of privacy invasions and intimidation people will tolerate. And the many "horror stories" recited at the conference indicate clearly that many people have already quietly put up with a good deal of abasement through invasions of privacy. On the other hand, a far more difficult task would be to try and find out what limits on invasions of privacy individuals would consider adequate to maintain their sense of dignity. How, in short, do you provoke people to express accurately what

is needed to restore an element of their dignity that is being imperceptively whittled away?

A related problem is deciding what action should be taken even if accurate information can be acquired. One workshop at the conference came to the startling conclusion that the decision as to whether an individual should be allowed to keep information secret or be obliged to give it to responsible authorities should be based on "the greatest good for the greatest number" principle. This is startling because about a dozen people actually agreed that the principle of respect for minority rights, one which seems to be crucial in decisions affecting privacy and openness, should be ignored.

4. The Legal Status of Privacy and Freedom of Information

> There are laws that protect, and have protected for many years, some areas of an individual's private life. I am thinking of such things as the laws of property and trespass; laws that incorporate certain fundamental human rights; laws of libel and slander; laws that grant confidential status to information that passes between, say, a doctor and his patient; and laws respecting the monitoring of telephone conversations. In practice, however, these laws do not provide an adequate protection of privacy. In Canada, for example, the use of miniature radio transmitters and electronic eavesdropping devices is not regulated . . . The law is often blamed for being static and always behind technology. This criticism is probably justified. If it holds true for the future, the consequences may even be more serious than in the past.
>
> \- A. E. Gotlieb,
> in a position paper

The laws cited above by Allan Gotlieb not only fail to provide "an adequate protection of privacy", as he puts it; in most cases they were not even intended to protect privacy. The law of libel, for example, is

intended only to protect an individual against unmerited defamation. It provides no protection against the exposure of sensitive information that is accurate! In Britain, the law forbidding wiretapping is not based on the individual's claim to privacy. Rather, wiretapping is prohibited because it is construed as theft of British Post Office electricity!

"The right of privacy is not one that has been given much recognition or protection in our law", Professor Douglas A. Schmeiser, of the University of Saskatchewan College of Law and chairman of a panel session on legal problems, argued. "It is not found in the Canadian Bill of Rights; it is not found in provincial bills of rights; it is expressly rejected in judicial proceedings, in most professional communications and in modern police practices." He was supported by Claude-Armand Sheppard, who declared simply, "The concept of privacy in law is relatively new. It is not unknown in Canadian law", he said, "but its recognition has generally been implicit rather than explicit. It has been dealt with in a piecemeal fashion and haphazardly."

Sheppard points to "token" acknowledgement of the principle the guarantee of mail secrecy in the Post Office Act, in various federal and provincial statutes prohibiting interference with telephones or wire-tapping; and in several provisions of the Criminal Code, such as those prohibiting the watching and besetting of individuals, dwelling houses or places of work and requiring a search warrant for an officer to penetrate into any private building. "In this connection, it should be recalled that a search warrant 'shall be executed by day, unless the justice, by the

warrant, authorizes the execution of it by night'".[1]

Sheppard also pointed out that Quebec law does not contain any specific provision dealing with privacy but that a proposed bill of rights contains a passage guaranteeing to every citizen a right to the protection of his dignity, his honour and his reputation as well as his right to privacy. Also, there is precedent, he pointed out, for using the general principles of civil responsibility in the Quebec Civil Code to prosecute invasions of privacy (see footnote below).

In summary, Sheppard and Schmeiser seem to agree with Professor Westin that privacy has been recognized in the past but the business of embedding measures in the law to adequately protect privacy has lagged behind technological developments.[2]

---

(1) Sheppard's remarks are buttressed by most Canadian writers on the subject. David Cornfield, writing in the University of Toronto, Faculty of Law Review, concludes that "although privacy receives some limited protection from the law of trespass, nuisance, negligence and copyright, no English court has ever given a remedy for invading the personal seclusion of an individual _per se_ apart from his occupancy of land or his holding of some form of personal property." Another writer states "with some confidence that English Law does not recognize the right to be left alone. Personal privacy as such is not protected as a right, nor is there any correlative duty imposed on other persons to prevent them from infringing it."

One recent exception is found in the case of _Robbins vs Canadian Broadcasting Corporation_, where the CBC was found at fault for inviting viewers of a program to write or phone and "cheer up" a doctor who had written a letter to the CBC complaining about the program. Using section 1053 of the Civil Code, "Every person capable of discerning right from wrong is responsible for the damage caused by his fault to another, whether by positive act, impudence, neglect or want of skill", the Quebec Superior Court found that the CBC had committed a fault and was therefore responsible, but that there was "no need to attempt any precise definition of this fault".

(2) Westin, Privacy & Freedom, pp. 330-364.

Hugh Lawford, on the other hand, argued in his position paper at the conference that "The common law has been reluctant to recognize a right to privacy because such a right would endanger a more fundamental right of free speech. Such restrictions as the common law has placed upon the freedom to communicate information have been narrowly construed. For example, the legal remedies which the law gives for defamation of character are quite limited. Even if someone has spoken about me in terms which bring me under public hatred, ridicule or contempt, I cannot succeed in suing him if he can show that the words used were true." Lawford also pointed to the tendency of the courts to reject claims to shelter whole classes of information that could be used as evidence.

Whatever the historical perspective from which one views privacy as a legal concept, it is clear that the concept has, at present,little firm basis in Canadian law. Only British Columbia, among Canada's eleven major governments, has a specific privacy statute. Also, there is little existing legislation to limit the activities of agencies that might otherwise invade privacy. A significant step in that direction is, of course, Justice Minister Turner's wiretapping bill, introduced in the House of Commons in the fall of 1970. But on the whole, there has been little action to circumscribe the activities of information collectors and little thought given to the legal problems posed by the emergence of "personal information" as a commodity and a tool for privacy invasion.

Another related gap in Canada law is the absence of legislation providing for what Turner calls "a right to know". He explained:

> There is another side to the right of privacy which has not received the prominence it deserves but whose dimensions cannot be ignored. This is the tendency

> of governments to abuse citizen entitlements under the guise of privacy. In other words, government secrecy is sometimes legitimated as the need for government's right to privacy but which may well be a denial of the public right to know. If privacy is the foundation of democracy, the right to know is fundamental to any participation in democracy. The public cannot be expected to dialogue - still less decide - meaningfully if it is refused the very information which would make such a dialogue and decision-making possible.

Professor Hugh Lawford explained in detail what the absence of a right to information means to a citizen trying to deal with certain federal agencies. "Canada", he said, "has never enacted a clear law respecting clearance of documents and access to unpublished documents." This gap exists with respect to both archive collections and documents still in the possession of government departments, he claimed.

> "It is even difficult to discover who is responsible for granting permission to see government documents. Until fairly recently, a common assumption was that access to Canadian government papers was subject to a "50-year rule". That is, any document 50 or more years old was regarded as open to the public. Yet it is difficult to find any legal authority for the 50-year rule or for the shortening of the period to 35 years announced recently by the Prime Minister. Certainly there are files older than 50 years which the government refuses to make available to the public.
>
> A Canadian finds it impossible to know what law governs access to government files. He has no assurance that a department even has the personnel to undertake clearance of its files. Indeed, the procedure for declassification and release of government files (if there is one) has never been publicized."

While both Turner and Lawford concentrate on the idea that the absence of "a right to know", particularly with respect to government documents, is dangerous to the functioning of the democratic process, it

should not be forgotten that this omission also has the potential to create a threat to individual privacy. This is because government officials, in possession of information they refuse to divulge, may be in a position to manipulate individuals, groups or the whole society. As A. E. Ende of the U.S. Federal Communications Commission and a conference participant pointed out, "The real danger to the individual is from government activity in gathering information, maintaining files and using them. We can be affected by the opinion of powerful people with privileged information."

CHAPTER II

INFORMATION AND INFORMATION SYSTEMS

If nothing else, the preceding chapter should have suggested that "information" is the villain of the piece. Information is the "commodity" that an individual often wishes to keep to himself while others covet it. And information, in certain situations, is the tool of the manipulator or blackmailer. To extrapolate from Bacon - as everyone does who writes on this topic - information is power! To which should be added the all-purpose qualifier - "sometimes". Some information never has any power, some has power only for a short time, some has power only in certain circumstances. Thus, R. J. Bouwman, General Counsel and Secretary of British Columbia Telephone Co., could scoff at the alarmist posture adopted by many people on this topic.

> "I am a little worried about the fear that everyone here talks about, the fear of everyone knowing everything about you. I don't particularly care who knows about me, about my bank account or anything like that. And I just wondered if it is true that there is such a terrible fear or is this just something that we're building up in people?"

Those remarks serve as warning that the circumstances by which a certain piece of information assumes power (or loses it) vary considerably, even unpredictably. The power of a given fact may depend on that fact not being widely known, it may depend on the time that it is learned or on any or a combination of several other circumstances.

The relationship between information's power and its ability to help or hurt people also varies a great deal. Sometimes, information that

is helpful has power, sometimes is hasn't. Sometimes information with a potential for harming people has power, sometimes it hasn't. Sometimes, information has power regardless of whether or not it will hurt people.

Sometimes, information has power regardless of whether or not it is accurate. We know, for example, that personal information contained in school records or credit files has an enormous influence on our lives regardless of its accuracy. For one conference participant, the terrifying thing about some kinds of information is that people believe them. "We live in a pseudo-scientific age," he said, "and people tend to accord more value to so-called scientific data than they should." In fact, the strategic unimportance of accuracy in situations such as these seems to confer an extra power on already powerful information. This results, as Justice Minister Turner suggested, from the fear that develops in people - a fear born of "the awareness of the potential for the information not being accurate - the veracity of the information, the sources from which it may be derived, the biases from which it may be derived, the conversion of information corralled for one use and converted to another, the fact that there is no opportunity for rebuttal if that information is assembled without one's knowledge and thereby without one's consent."

On the other hand, people don't care about the veracity of what they apparently consider to be innocuous information. One conference participant reported the attempts of his company to verify the accuracy of information on its mailing list. He said that if the company pays return postage, 25% of those asked will reply to requests for verification of information. If the company doesn't offer to pay return postage, only 8% will respond. "75% just don't care anyway", he said.

In the midst of such disconcerting ambiguities surrounding information, at least one of its characteristics is fairly well understood. Fortunately, it happens to be the one with which the conference was most concerned. That is the tendency for information that already has some power to become more powerful as man's ability to store and manipulate it improves.

In other words, with each invention - hieroglyphics, the alphabet, paper, the printing press and so on - that has increased man's ability to store information, so the potential for an institution or an individual to accumulate information that can be used to advantage has grown. And more recently, with the development of mechanical, electro-mechanical and finally electronic devices for manipulating and analyzing information, this potential power has flowered even more rapidly, as is illustrated in a subsequent chapter.

Obviously, new methods and devices for storing and retrieving information were not developed in a vacuum. There were needs for them, needs expressed by people who explicitly or implicitly understood the value of collecting, storing and manipulating certain kinds of information. The result today is a proliferation of stores of information of all kinds held by all shapes and sizes of individuals and organizations. Some of these information stores, whether they are called filing systems, information systems or data banks, are kept on computers; some are kept in a man's head. Some, such as the telephone directory, have wide circulation; others, such as national defense systems, have extremely limited circulation.

The practices and problems of some of the information systems that

interested conference participants most are explored in this chapter. Also, ways in which information systems might be classified so as to separate the powerful from the innocuous are suggested. No attempt is made in this chapter to discriminate between manual information systems and computer-based systems. The problems considered here apply regardless of the storage and manipulation vehicle. The impact of the computer of information systems is the subject of a later chapter.

1. Some Information Systems: Existing Practices and Policy Problems

The conference was particularly interested in information systems containing information on people. Thus, discussion focussed on systems operated by credit and personnel agencies and by government and para-government agencies. The result was enlightening for, as Justice Minister Turner pointed out, we don't know much about them.

> The information systems dotting the national landscape in both the public and private sectors - and which are being increasingly integrated around computerized data banks - know a great deal about us but we know very little about them. What we need today is some hard data about the information systems and computerized data banks themselves, - i.e. - their number, type, nature, location and function; the ownership of these information technologies both in respect of nationality and public participation; what kinds of information are being collected, stored, retrieved, transmitted and disclosed; what measures, if any, have been already installed in these information systems to protect individual rights; how effective these measures are; and the operative trends in terms of information technologies and computer data banks in the Seventies.

Three panel speakers outlined the activities of credit bureaus, the Dominion Bureau of Statistics and school boards respectively. Open discussion elsewhere illuminated some of the practices of other data

collectors in our society.

M. T. Pearson, general manager of the 153-member Associated Credit Bureaus of Canada, spoke on the methods and policies of credit bureaus. He emphasized first the role of credit bureaus in society.

> "Outstanding consumer credit has multiplied five times since 1951 to an approximate total of $9,000 million today. ACB of C's 153 members provide more than five million factual and usually brief credit summaries a year, most of them by telephone, to more than 40,000 subscribers."

He claimed that member bureaus, however, do not grant or refuse credit, do not employ investigators who probe into an individual's background and habits, do not keep files secret from the individual concerned and do not provide credit reports to everyone who seeks them.

To protect the individual, ACBC policy requires service contracts between the bureau and subscribers certifying that "inquiries will be made only for the purposes of credit granting and other bona fide business transactions, such as evaluation of present and prospective credit risks. Service is discontinued to any subscriber who fails to honour these provisions. Subscribers pay an annual fee plus a charge for each credit report granted. To obtain information, a subscriber must identify himself by giving a special code number assigned on contract agreement.

"Furthermore, any consumer is able to find out what information is contained in his credit bureau file. He simply phones the bureau and makes an appointment. He is asked, on his arrival, to provide proper identification, then a member of the bureau's supervisory staff will go over the contents with him."

Pearson emphasized that files contain factual material only. He pointed out that credit bureaus have come to realize that a person's habits, political affiliations, etc. are not relevant. "The important thing is whether or not he pays his bills. Also, we won't store information we can't sell."

Thus, files contain a person's name, age, residence, previous residences, marital status, family, place of employment, previous places of employment, estimated income, paying habits and outstanding credit obligations.

"Bureaus may only record judgments and/or writs having to do with consumer debt; registered chattel mortgages, conditional sales contracts and convictions under provincial statutes and for criminal offences."

"Bureaus will report bankruptcies for 14 years, and collection accounts, judgments and court convictions for seven years."

Pearson also presented a table resulting from an ACBC research project in 1968 showing a low level of consumer complaints with the credit service (see Table I).

Finally, he noted that "no Canadian bureaus are currently computerized or have firm plans to do so". This despite the fact that ACBC's U.S. parent and other U.S. credit bureaus have put their files on computers.

"Several segments of the (Canadian) industry, in major market areas, have conducted studies but for volume or other reasons have not proceeded as of this date", he said.

TABLE I

Consumer Complaints Received and Interviews Completed

By Representative Sample of ACBC Members

1968

Region	Total # Of Reports 1968	Total # Of Complaints Received (Interviews Completed)		Total # Result Of Misunderstanding Of Business Function*		Total # Result Of Mistaken Identity		Total # Result Of Other Errors	
		#	%	#	%	#	%	#	%
Maritimes	317,717	887	0.28	423	0.13	89	0.03	90	0.03
Quebec	1,099,280	914	0.08	823	0.07	31	--	40	--
Ontario	1,662,587	3,114	0.19	2,015	0.12	47	--	69	--
Prairies	627,123	2,509	0.40	1,498	0.24	108	0.02	105	0.02
British Columbia	570,285	2,081	0.36	1,156	0.20	95	0.02	44	0.01
CANADA	4,276,992	9,505	0.22%	5,915	0.14%	370	0.01%	348	0.01%

* In nearly all cases, this was the belief that the bureau actually approved or disapproved granting of credit.

"Most members of the industry, however, recognize that computerization of some form, beginning in major markets, is inevitable, and largely a matter of volume, equipment economics and investment payout. On this basis, it is reasonable to assume that a significant proportion of the Canadian industry will be computerized in 5-10 years, and some major markets sooner than that."

Pearson's remarks pertain mainly to the Associated Credit Bureaus of Canada, a group of "in-file" reporting agencies. Subsequent discussion illuminated the activities of other participants in the personal information collecting industry. Professor J. M. Carroll of the University of Western Ontario, pointed out that, "for all practical purposes", there are three such organizations in Canada, the others being Dunn & Bradstreet, concerned primarily with businesses and large investors, and The Retail Credit Co. of Canada. Carroll emphasized that it is mainly The Retail Co., that carries out investigative work on individuals for the use of insurance companies and the like. He called this kind of activity "bedroom or bistro spying." All of the agencies, he added, are headquartered in the United States.

Carroll also disputed Pearson's claim that an individual can review his file.

"He has said that a subject has the right to review his file but it would be misleading if one would think that you can walk to a credit bureau, get the document, which they call the docket, and hold it in your hot little hands and examine every statement made about you. This is just not done."

"You make an appointment", Carroll continued, "to review a file at the credit bureau - this is Mr. Pearson's organization. I do not know if the

other organizations have even gone this far. Now, the manager of the credit bureau holds your file and he says, 'Mr. Jones, now just what was there about your credit status that is troubling you?' In other words, he's playing 'twenty questions' with your file and he is putting you in a position where you have to volunteer information, perhaps derogatory information, that might not be in the file in the first place. I say that this right to review a file is not that; it is only the right to subject yourself to a personal interrogation."

To which Pearson replied: "The file is in code for confidential purposes. He wouldn't understand the file anyway so we have to interpret it. It would go like this. It might say, 'F - 100 - 1 - 69 - 1,000 - $60 - 800 - 01'. The main point here is that on the docket are confidential codes that the member uses to phone in. Now, if we hand somebody the docket and he picks up the code, he can go out and give the code to some of his friends and he in turn can phone into the bureau."(1)

Some of the personal information handling activities of the Federal government were outlined by T. J. VanderNoot of the Dominion Bureau of Statistics.

He pointed out that the Canadian Statistics Act guarantees to the individual that no harm will come to him as a result of his compliance with the Act in providing information to DBS.

---

(1) For further information on the personal information-gathering industry in Canada, see Gibson, R.D. and J.M. Sharp, Privacy and Commercial Reporting Agencies, Legal Research Institute, University of Manitoba, Winnipeg, 1968.

> The protection of individual returns covered by the Statistics Act includes the following three major provisions: (1) the individual returns furnished by persons, businesses, etc. will be used only for statistical purposes and not made available for taxation, regulation or other administrative action; (2) the returns will be handled only by sworn staff to DBS; and (3) the data will be published only in a form which will not permit, without authorization, the identification of data relating to any individual form or other respondent.

Despite precautionary measures taken to ensure that these protections are respected, VanderNoot noted there are difficulties, particularly in the area of residual disclosure.

> This occurs when two or more sets of data taken together could allow the identification pertaining to an individual respondent even though there is no direct or intentional disclosure. The trivial example occurs when an entry in a table is blanked out but which can be deduced from the marginal totals and the other entries in the table. A less trivial example is the publication of certain industry totals by province when one cell is dominated by a single respondent.

The "residual disclosure" problem illustrates a point made during a workshop session. Information contained in a data bank on an individual need not include the individual's name in order to be identifiable.

Another danger is implicit in DBS using information collected by other government agencies and departments of administrative purposes.

> This is an increasingly rich source of statistical information since the administrative activities of modern governments encompass ever wider spheres. Yet the public is concerned that the accumulation of information about individuals within one agency will allow the linkage of information from various sources and thus create the feared 1984-type dossier.[1]

---

(1) For further discussion of the "linkage" problem and an example of it in action, see R. H. Donnelly case, Chapter III.

A para-government data collection agency that received some attention was the school system. Ontario M.P.P. Tim Reid, explaining in a panel session the reason why he introduced a private member's bill on data banks, recalled that:

> "I was becoming increasingly alarmed at what was taking place with regard to elementary and secondary school student records, particularly with the advent of report cards during the 1960's on which the teacher was encouraged to express very subjective comments on the pupil's social behavior in and out of class, his relations and bad and good habits and so on. In other words, I was alarmed that very subjective comments of a psychological nature were being made by amateurs with no training."

Reid was concerned not only with this activity but with the fact that these observations are recorded on student record forms that follow the student throughout his academic career. Furthermore, he argued, supported by Professor John Carroll of the University of Western Ontario, that the distribution of these students record forms is often not adequately restricted.

As Carroll put it: "It's not unheard of for the principal of a school, in answer to a request for information on a student, to xerox a copy of the student record form and send it out to the individual making the inquiry". But he also pointed out that, "there are already laws regarding the confidentiality of this document. I believe it is under the Secondary Schools Act. So, you see, we are talking about more legislation but we don't even have the mechanisms to enforce the protections we already have written into legislation."

Reid also cited the instance in Toronto in June, 1968 when police asked for and received the student record form on a 17-year old former high school student who was to be a Crown witness in a court case.

Valuable insight into the activities of yet another group of data collectors - social scientists - was provided by Thomas McPhail of Loyola University. With one example from his own experience, he pointed out both the value of social science research and some of the latent dangers to both individuals and the scientists involved in it. The example deals with marijuana research.

> I designed a questionnaire along with a couple of colleagues and at question eight, it says, "Have you ever smoked marijuana?" Then, further questions are, 'how many times?' and 'how many times have your friends smoked it?' Now, on the top of that questionnaire, it says 'this questionnaire is both anonymous and the data will only be reported in agregates.' This is very sensitive research but the findings, I think, provide us with insights about human behavior that are very vital in terms of decision-making. For example, we have found that among freshmen, 12% have smoked marijuana. By the time you go through first, second, third and fourth year undergraduate, two-year masters program and a three-year PhD program, it goes up as high as 80%. In other words, the Federal legislation as it is designed today, if it were enforced, would put most of the intelligent young leaders of tomorrow in jail. I think it's this type of research that we need and it's this kind of research I'm afraid may be closed off.

Asked if the police authorities could lay any claim on his data in this research project, McPhail answered, "they probably could force me in some legal way but if I became aware of this I'd destroy the data first."

2. Classifying Information Systems

The purpose of the conference, of course, was not to itemize the information systems operating in Canada today. The focus on some specific information systems above, however, helps to indicate some of the problems that arise in dealing with them, even if and when they are itemized. One

point that should be clear, for example, is that the term 'information system' can cover everything from the telephone book to the RCMP's criminal files, from Eaton's catalogue to a company's confidential customer list or a school board's file of student histories. And any attempt to deal with them all collectively will almost certainly lead to some bizarre traps. As an example of what can happen, Hugh Lawford showed that the strict wording of Tim Reid's private member's bill on data banks would render illegal the publication of telephone books![(1)]

"If you look at the bill", Lawford said, "I suppose that when you compile a phone book, you are keeping 'a filing system that records and stores information'". He then showed the phone book would qualify under section 3E of the Ontario M.P.P.'s bill because it is sold, and under section 4 because it is 'a data bank that contains personal information about identifiable persons'. Lawford concluded triumphantly with the thought that if someone discovers any incorrect or out-of-date data in the phone book, he can order the phone company to expunge it or correct it immediately or face a $10,000 fine.

Another example of how legislation, if drafted too widely,could do more harm than good, is the possibility, raised by some conference participants, that an individual's personal files could become subject to regulation - including scrutiny by those about whom the information is stored - on the grounds that 'personal files' constitute a data bank.

Examples such as these indicate that a way must be found to classify information systems and to assign names to the different classifications. Somehow, the sensitive must be separated from the innocuous, the information

(1) See Appendix IV for the text of Reid's bill.

systems with restricted distribution must be separated from those that are open, and so on.

In a position paper on the classification problem, Professor C. C. Gotlieb of the University of Toronto and Program Chairman of the conference proposed to classify information systems according to three characteristics: the source of the information, the extent of distribution of the information and the method by which an individual can (if he can) inspect the information about him that is stored.

For data sources, he noted that information can be supplied either by the individual or from public record or from other sources, "other" being defined by exclusion. The only problem area here, he noted, is clarifying what is meant by 'public record'. For example, do vehicle registrations, records of criminal convictions, voters' lists and so on all belong on the public record? Gotlieb cautioned: "Careful thought would be needed to choose the list and it would have to be reviewed in the light of experience."

Under the 'inspection' classification, he suggested that, depending on the system, the individual either has an automatic right to inspection, in which case a copy of information held on him is sent to him automatically periodically or he has a right to request to inspect the information or he is forbidden to see his file altogether.

As for extent of distribution of the information, Professor Gotlieb put forth two categories, internal and external, but readily admits these are "the most difficult to define".

> Generally, internal is intended to mean that distribution of information is restricted to the company or institution which maintains the information system unless there

> is explicit permission of the individual about whom the data pertains, in every individual case, to transmit it elsewhere. However, in the case of government, federal or provincial, the organization is so large that it would be necessary to be much more precise than this, if the term 'internal' were to have any validity. If it turned out that it were not possible to define internal distribution with enough precision, it might be necessary to consider distribution for specific items of information rather than for the whole contents of the systems.

Professor Gotlieb then gave some examples of classification that would be assigned to familiar information systems. A payroll file is composed of data collected from 'other' sources (i.e. not the individual and not public record); it has only internal distribution; and the individual can, presumably, inspect it on request.

A police file is also made up from "other" sources, but it has external distribution and is not open for inspection by the individual. Who's Who is compiled from data supplied by the individual, it has external distribution and the individual has an automatic right to review his file.

> "Most of these information systems have a long history of use. Regulation of information systems could proceed first by identifying those of the type for which the individual has no right to scrutiny but which have external distribution. For all others, no regulations would apply. This would in itself encourage those operating systems to make their data open for inspection to the individual concerned, and to restrict general disclosure if possible, so that regulations would not apply."

In his remarks at the conference, Gotlieb added: "The whole purpose of the mechanism would be to indicate a very wide set of classes of systems on which generally no regulation or licensing would be needed. The whole point of the classification systems is to remove from any licensing need practically all the information systems that are operated, even about people."

The idea of classifying information systems was a popular one at the conference, although it emerged more in an awareness of differences between various types of information than in an understanding of what can be done about these differences. For example, one workshop suggested there is a vital distinction to be made between subjective and qualitative information on the one hand and objective, quantitative information on the other. It also noted a distinction between information that is collected for research purposes in which individuals are not identified and stored personal information that can be traced back to the individual. Another workshop, although in favor of complete disclosure of government and corporate information, recorded the following stumbling blocks:

> "Information relating to the future operations of companies, such as project capital expenditures, competitive information within the industry, etc. cannot be disclosed without jeopardizing the company. Other information, such as proposed location of highways or that affecting the stock market must be withheld."

It is likely that most, if not all, of these differences could be accommodated if the principles of Gotlieb's classification system were applied. Gotlieb himself emphasized that he was attached only "generally" to the classifications he set up, not to the specific classification suggested. One general area of disagreement, however, might be over the use to which information is put. Gotlieb, for one, was not interested in how information is used. "Let me point out", he said, "that I do not try and classify according to how information is used. I think that one of the aspects of information systems is that they have all kinds of uses that you didn't think of. And to try and expect that you can predict all the ways in which you can use it is probably not too productive."

If the workshop reports are a fair indication, his view is not widely shared. Three workshops noted that the uses to which information is put are of great concern to people, although none offered any reasons for this. Examples given included the use of personal credit data for employment purposes and the fear that confidential communications to doctors, priests and lawyers might be used for other purposes. Another workshop complained about the sale of magazine mailing lists. One workshop, however, came to the conclusion that people, in giving out certain types of personal information, waive the right to restrict its use. No examples were given. Dr. Willis Ware of The Rand Corporation argued in one workshop that the apprehension of use of information by third parties may arise simply because "we are afraid of the future. This is the emotional failing in all of us", he said. "We are worried about the gathering of medical information, for example, even though we're better off as a result of it. Why not reveal the identity of the individual?" But Ware also suggested data bank operators should be forced to declare the uses to which they put their information

Chapter III

COMPUTERS AND INFORMATION SYSTEMS

> "I'd be very sympathetic to recognizing a right of privacy for computers too."
>
> - A.E. Gotlieb

> "A computerized system can administer injustice far more efficiently and far more quickly than any manual system."
>
> - from a workshop report

"Computers are big, expensive, fast, dumb adding-machine-typewriters", according to Robert Townsend, author of Up the Organization. Perhaps. But this definition conspicuously omits the two other characteristics of the computer that cause it to affect traditional approaches to information systems. These are the computer's abilities to store vast quantities of data and to retrieve, sort and analyse that data under programmed control at lightning speed. John J. Deutsch, principal, Queen's University and chairman of the panel session on legal and social concepts of privacy, explains:

> "in the past, we've had a protection from the limitations of the written word. While a lot of information could be collected, it was cumbersome, it was difficult to find, certainly difficult to find quickly, and this has given the individual a good deal of protection as far as privacy is concerned. It was like looking for a needle in a hay-stack. Well, what's happened now is that we can indeed find the needle."

Perhaps the best illustrations of the computer's ability to find needles in haystacks was that described to the conference by T.J. Vander Noot of the Dominion Bureau of Statistics. He said that a U.S. marketing

firm, R.H. Donnelly, Inc., brought together available public information on individuals living in a certain district. The information sources used were the enumeration area statistics from the census bureau, the telephone book and the auto registration list sold to them by the state. All this information was fed into the computer and correlated. And, from the results, "they were able to infer a great deal about the families living in the area they were interested in", Vander Noot said.

"I would point out", Vander Noot continued, "that the invasion of privacy is not just a question of dossiers or the illegal collection of information. But as social science itself becomes more sophisticated, perfectly legal means can be used to build up files of information about a person which is an invasion of privacy. And I would defer to the lawyers the question of how a series of perfectly legal actions can result in an invasion of privacy."

As luck would have it, a lawyer, Allan Gotlieb, took up the challenge, answered the question and showed that there is even a legal principle to support the suggestion that computers can bring about a qualitative change in information systems through a quantitative increase in capacity and manipulative power.

> "I can remember the story a law professor once gave as explanation of the relationship between what is legal and what may become illegal. A farmer keeps one pig and this is perfectly permissible; he keeps two pigs and it's permissible; three pigs and it's permissible, but at a certain point he may keep sufficient number of pigs that the pigs become a nuisance in relationship to his neighbor. So that at some times, information or actions which in themselves in isolation may be perfectly permissible can by society be regarded as changing in quality and their character in a certain combination. I

think for example, that it is quite possible that under the laws of a given jurisdiction, the legislators may say that there shall be no bank of information formed on people by public or private (agencies) of a certain character or of a certain type even though the information may be public or, in large part, publicly available. I'm not advocating such an approach but I think it is certainly likely to happen in relation to the formation of general data banks on people by governments."

1. How Computers may Become a Nuisance

The conference summary report records "the predominant opinion" that the computer can indeed alter the "quality" of the invasion-of-privacy problem through its impact on information systems. The R.H. Donnelly case cited above by Vander Noot presents one way in which this can happen; that is, through the use of a computer to sort, compare and integrate various data files so thoroughly as to create a qualitative change in the data itself. But there are several other ways in which the computer can affect information systems and, in the process, either directly or indirectly, affect individual privacy too.

Consider, for example, the following prediction by Douglas F. Parkhill of the Department of Communications:

"The technical advances that had made possible the information utility(1) have dangerously magnified the power of both governments and private organizations to keep all of us under close surveillance. Together, the various data files of the different (systems)--medical, educational, financial, legal, law enforcement, etc. could make available in a conveniently accessible form a complete record from birth until death of even the most private affairs of everyone. In the absence of adequate controls, this could create a dangerous menace to the right of privacy, and, if carried far enough, to a society in which conformity would become the price of survival."

---

(1) A term used by Parkhill to describe the massive computer-communications systems he predicts will be prominent in the near future. See below, page 55.

While the computer in this instance is doing much the same things as it does in the Donnelly example, a completely different legal problem is involved. What Parkhill alludes to is the possibility that governments or private organizations will integrate already confidential data files containing personal information, perhaps in the name of efficiency or money-saving, but nevertheless resulting, willy nilly, in a bank of personal dossiers that individuals, had they been asked, might never have agreed to establish.

A third way in which computers may impact information systems is implicit in Principal Deutsch's reference to being able to find the needle in the haystack. Simply because of the computer's immense memory and its manipulative powers, information systems can be built and used today that could not have been contemplated in the past. And many existing information systems, if placed on a computer, would become instantly, for these reasons, more powerful tools.

As A.E. Gotlieb noted, "Before the advent of the computer, files on the various activities of an individual were incomplete and separated from each other because too large a mass of information simply could not be manipulated economically. The computer, however, makes it possible and economic to store, combine and transfer masses of data."

A fourth way in which computers may affect information systems and, obliquely, privacy, is through their tendency, cited emphatically by Hugh Lawford, to turn previously 'free' information into a commercial commodity. "Because computer-based information systems are expensive and

can be controlled in a way that the flow of private paper cannot", Lawford argued, "Ithink that there is a tremendous pressure towards having information become an economic commodity.[1] So that it is possible to say that every time someone looks up a law on a computer data bank he should be charged a fee." Lawford also commented that in seeking legal documents from governments for use on his data bank, he noticed that they have begun to ask for some "economic benefit" for providing this information in a way they wouldn't have done in the past.

The implication is that this cost element, if it becomes generally accepted, could become another factor in expanding the gap between those with the power (and the money) to manipulate information and those who are manipulated.

Finally, Claude-Armand Sheppard, in his position paper and in direct remarks at the conference cites a fifth way in which computers alter information systems and, in the process, upset people.

> "To put it crudely, it is the fear of being ruled by computers. You and I know that this is a great over-simplification. We know that computers are really most suited for repetitive tasks. In fact, it has been said that computers don't think, don't make decisions, don't set policy. Don't they really? Most decisions which any administration has to make really consist in the application of relatively plain rules to facts which are equally simple. But to the individual concerned these simple, almost mechanical, decisions may be of the utmost importance, for they determine his rights, his security, and vital aspects of his life. Yet these are the decisions which are most likely to be entrusted to computers.

---

(1) Even more so when there is a telecommunications link between the "customer" and the computer system.

> Up to now, the citizen's main contact with his government has been in areas such as taxation, social aid and so on. Yet these are the areas that are being taken over by computers. Don't underestimate the anguish this will create in people."

It must be emphasized - indeed, it was emphasized several times at the conference - that these are, for the most part, ways in which the computer, when and if applied to information systems, has the potential to bring about invasions of privacy where none existed before or to exacerbate existing privacy invasions. Today, as M.T. Pearson pointed out, no credit bureau in Canada uses computers to store its information. Only governments have significant personal data files on computers but even there one finds curious gaps. The R.C.M.P., for example, still does not have an on-line criminal data file(1). In short, the state of the operational art is, as usual, somewhat behind the technical state of the art. Nevertheless, there was considerable debate at the conference both on the technical and economic feasibility of harnessing computers to most information systems.

2. Financial and Technical Feasibility of Computerized Information Systems

Three conference panel speakers, B.B. Goodfellow of IBM Canada Ltd., D.F. Parkhill, Assistant Deputy-Minister, Planning, Department of Communications and John M. Russell, Vice-President, Systems Dimensions Ltd., Ottawa, spoke on technical and financial aspects of computerized information systems. In addition, there was limited discussion in workshops, but no major points are raised that are not covered in the three speakers' papers.

---

(1) One is, however, now under development. The RCMP announced in September 1970, its intention to develop an on-time data bank containing information on stolen vehicles and on criminals. The system will connect to the U.S. Federal Bureau of Investigation's National Crime Information Centre (NCIC) in Washington, D.C.

In general, Parkhill claimed that computerization of information systems is not only technically and economically feasible, it is already happening "at a phenomenal pace". Russell and Goodfellow, for their part, concentrated on pointing out technical and economic obstacles to the rapid emergence of computerized information systems.

"For the rest of the decade at least", Parkhill argued, "the most significant developments in information systems will arise from the merging together of the previously disparate disciplines of computers and communications to create those new forms of social endeavour that we call information utilities."

And he described several technical advances that have made this possible.

1. It is now technically feasible to bring the full power of a large-scale computer complex to anyone in the world who is served by suitable telecommunications facilities.

2. The interaction between the central computers and the remote user is essentially instantaneous so that the user receives service that is indistinguishable from that which he could receive if he were physically present in the same room as the computers.

3. The cost to each user is but a small fraction of what it would be if the same services were provided by individually owned computers.

4. Each subscriber can be provided with expandable, rapidly accessible private files that are reasonably well protected against unauthorized access.

5. The intellectual achievements and data collections of many individuals and groups can be pooled in large public files so that their contents become simultaneously available on demand to all customers of the system.

6. The technique of time-sharing has made direct dialogue between man and computer economically practical.

Parkhill then described some information systems that will be computerized in the future, and suggested some of the effects this computerizing process will have on these systems. He cautioned that "any complete list of possible applications would resemble the index to the Encyclopedia Britannica", but offered a preliminary list of some of the potentially important ones (see Appendix 5).

Perhaps the most important of the future computer-based information systems described by Parkhill are those intended for pedagogical purposes.

> "In the long run, nowhere will the impact of the computer utility be felt more strongly than in the area of education. Both the form of the school and the role of human teacher will undergo drastic changes as "fireside computer consoles", universal electronic encyclopedias, teaching utilities and academic administrative utilities come into widespread use. For one thing, the concepts of grades and of classes based on calendar age may have to be abandoned. In their place will be a system of independent tracks for each student, according to his individual performance. In fact, with the advent of domestic computer utility service, there is no reason why much of a student's instruction and study could not take place at home. The time at school could then be devoted to laboratory work, group discussions and seminars and individual consultations with the human teachers."

John Russell, Vice-President, Research & Development, Systems Dimensions Ltd., Ottawa, in a panel presentation, presented some of the technical and economic difficulties and limitations in creating large on-line, computerized information systems. Russell claimed that, "using currently available technology, no significant storage capacity limitations present themselves to the designer of an on-line information service".

"Direct access mass storage devices presently offered for sale can make available to today's computers upwards of one trillion characters of information at a capital cost of approximately $10 million. Such a capacity would provide for approximately 10,000 words pertaining to every person in Canada at a capital cost of approximately 50¢ per person".

These data files could be stored far more cheaply, Russell noted, if they were put on off-line tapes rather than direct-access devices. "The above hypothetical files, for example, would be contained in approximately 25,000 reels of conventional computer tapes at a capital cost of less than 5¢ a person."

One of the major areas of technical difficulty in on-line systems, he claimed, is in the speed of access to information in the files.

"Although the access times and data transfer rates may be quite high, when the designer takes into account auxiliary operations such as access request queuing, location directory searching, field password verification, privacy transformations, record rewriting and directory updating, he would consider himself cavalier to predict much more than about one thousand accesses per hour. This means that just one of the possible data bank access applications alone, motor vehicle registration for example, could tie up the system completely (three million vehicle registrations spread over 300 days = 10,000 registrations per day or 1,000 registrations per hour).

Russell added that the access-time problem is more acute in data banks used for 'specific' purposes than in those used for statistical purposes. In other words, when data files are accessed for purposes of statistical analysis, they can be drawn one after another in their natural physical sequence from the storage device. However, in cases where specific data is required, an individual (time-consuming) search is required for each item.

Russell also focused on some start-up problems that any would-be data bank operator would incur. For example, "the building process will generally require a manual conversion involving the transcription of the records to machine readable form. Perhaps the first and most immediate danger to the individual lies in the difficulty of ensuring adequate quality

control during large-scale conversion programs. And because transcribed records of an individual may not come in to actual use of months or years after the transcriptions, errors introduced at that time will tend to be difficult to right." He also claimed that this transcription process is "extremely expensive" and "in many cases, this cost alone could prohibit the transcription."

A design problem, which Russell discussed briefly, is whether to have one centralized data bank or a network of smaller, distributed data banks. Against the distributed option, Russell pointed out the high cost of transmitting data from one centre to another for - say - analytical purposes. And he cited the following hypothetical example:

> "An authorized researcher working out of one of the regional centres such as Quebec City wishes to study current health patterns of families in Ontario and Quebec. Having in hand a tape file derived just last week from the Quebec City data bank, he asks for the corresponding file from Toronto. Stressing the urgent nature of his research (e.g. mercury pollution), he asks for and receives permission to have the Toronto file forwarded by leased common-carrier communications facilities.
>
> "Now, the Ontario health records file may happen to contain six million records of 200 words each (roughly 50,000,000,000 bits). Since, in the current state-of-the-art, data transmits at a maximum of about 50,000 bits per second, our researcher in Quebec City will wait some two weeks for his data!
>
> "Although perhaps the transmission cost was not important in this instance, it is interesting to note that under current tariffs, the common-carrier tolls would have exceeded $7,000. Ordinary air express services could have been used to ship the tapes in less than one-tenth of the time at less than one-tenth the cost!"

To Russell's remarks must be added those of B.B. Goodfellow of IBM Canada Ltd. Goodfellow spoke mainly on the anticipated technical

developments in computer design in the near future that will impact the technical and economical viability of computerizing data banks.

"Today", he said, "we can visualize the technologies that will take us to absolute limits in central processor performance. By the mid-1970's it is reasonable to project 1- to 2-nanosecond systems and by the early 1980's, we should attain an order of-magnitude improvement with circuits in the 100-picosecond range. This achievement would appear to represent a limit for practical systems for some time beyond that period for the linear machine."

Goodfellow warned, however, that "based on the very limited experience with the design of current information systems, it is projected that search times (CPU to core) will have to increase between a thousand and five thousand times to make even relatively simple information systems practical." And, he said, "the projections of circuit improvement do not support such increases."

Also, in the organization of computer processors, Goodfellow claimed: "The current indication would be the development of multiple processor systems operating under the control of a master operating systems. A number of breakthroughs will have to occur in this area before system performance will satisfy the implied requirements of many of these proposed data banks."

Again in the area of bulk storage media, he noted that while there is no limit to the amount of information that can be stored, "It is an unfortunate fact that increasing storage generally increases access time." He foresees improvements in storage media over the next decade, to the

point where "very large systems (i.e. with on-line storage in the range of a billion characters or more) will be practical for the expansion of many applications in operation today, but they will have unacceptable access times to operate in realtime mode. Some of the new technologies may overcome the basic limitations encountered today but these systems appear to be beyond a ten-year forecast."

3. Security of Computerized Information Systems

Just by being themselves, computers can bring significant changes to information systems that may affect personal privacy. But computers and computer men aren't always themselves, don't always do what they are supposed to do. They make mistakes, they may not have adequately considered a problem and, in the case of computer men, they may become sloppy, negligent or simply dishonest. As a result of any of these eventualities, sensitive personal information stored on a computer may be distributed to someone who shouldn't have it or may be corrupted. In either case, personal privacy could be unjustly compromised. Steps taken to avoid such eventualities fall under the general rubric of security in the computer environment - a topic of considerable concern to many conference participants and, one suspects, to the public at large.

As a list of security requirements provided by Dr. Willis Ware indicates, the steps to be taken are considerably different from those in a non-computer environment. He cites five requirements.

1. Physical protection of the computing central and demountable storage media.

2. Communications should be protected by some form of encryption or physical protection of circuits.

3. A multi-user system must have hardware safeguards to prevent a user from upsetting the monitor program or software safeguards.

4. Software safeguards are needed to control user access to files and make audit trails, alert staff to unusual situations, etc.

5. Administrative and management security controls must be adequate.(1)

Given that these various approaches to security in a computer environment are followed up, the question remains as to whether computer-based information systems are or will be more secure than manual systems. The question is, of course, largely academic because there is as yet little experience in the field. Here, however, is a sampling of opinion and evidence from various conference participants.

B.B. Goodfellow of IBM Canada Ltd. argued that, "while technological developments may represent a potential threat to privacy, this same technology may be even more important to use in the protection of privacy. Whether we like it or not, our lives are not very private today and I am convinced that computers and automated data banks offer the potential for greater protection of our privacy than the threat they present to its invasion."

Concrete evidence for this idea appears in M.T. Pearson's paper on the operations of credit bureaus. "It is our contention", he said, "that computerization will in fact promote greater accuracy and confidential treatment of file information."

Pearson went on to suggest what some of the specific effects of computerization of credit bureaus would be:

---

(1) Legislation or regulation draftsmen may, or may not want to consider the irony of a computer system operator invading the privacy of his employees in order to protect the privacy of his customers.

"Computers are vehicles by which many credit bureaus' files can be consolidated into one metropolitan trading area. To the credit grantor, it means he can call one location to get information on potential customers in the total trade area which he services. To the consumer, this means a much quicker opening of a new account since the credit bureau would no longer have to mail a request for information to another city in those cases where the consumer has recently moved.

"Computers can control against errors more efficiently than is possible with manual systems. For example, more checks for reasonableness of data input are contained in the computer systems than are possible on a manual basis. Computers permit an automatic interface between the automatic billing systems of credit grantors and the credit bureau's files. Computers for credit reporting are all on-line systems. Correction of errors can be entered in these systems as quickly as they could be entered in any manual system. With computers, there is a new ability to go through files quickly and delete older information that should no longer have a bearing on the person's ability to pay.

"Computers permit bureaus to have greater checks to guard against misuse of their files than is possible on the manual basis. In the U.S. Associated Credit Bureaus computer package, Credipak, a complete audit trail is maintained on every access and change to the file, including an operator's identification. No terminal can access the files until such terminal is activated by a supervisor and the assigned operator has identified herself on that terminal. Any terminals placed in credit grantors' offices for direct access to the bureau's files are not permitted by the computer software to make changes to files other than to indicate that an access has been made. The system also produces lists of all significant changes made to files which require some supervisory review."

Pearson's contentions were further supported by David Booth of I.P. Sharp Associates Ltd., Toronto. Booth described in detail the secutiry system incorporated into the company's computer time-sharing system in Toronto. Like the Credipak system, the I.P. Sharp system aims at providing a high degree of file integrity and security.

The system provides each user with a 7-digit entry code number. "While this code may remain unchanged for many months, the user may append his own password of up to eight characters and change it any any time,"

Booth said. The user, once his code has been accepted by the computer, may then use the machine to perform mathematical functions or to store and then execute a user-made program.

"The most important point to note is that when a function is written it can be locked so that no one, not even the function designer or the console operator, can see how the program works, or can change it. It can never be unlocked. It can only be erased," Booth pointed out. "Not only can the user protect his account number and the contents of his programs but also units of storage called workspaces", he added. "Should the need arise to store a security program before it is finally locked, it can be stored in a workspace which itself is protected by a password of up to eight letters.

"The degree of security employed is in the hands of the user, which is important because security usually costs money in both user's time and computer costs."

Despite these reassuring remarks from Pearson, Booth and Goodfellow, there was considerable uneasiness among conference participants about the security of computer systems, particularly in systems that do or will contain personal information about individuals.

J.S. Crowson of the Department of Communications argued that "the computer is only as good as the system that operates it". Citing the experience of the Canada Post Office in devising money order systems, he claimed, "People may devise many wonderful systems and for a short while they confound the crooks. But it isn't very long before the professional thieves find a way to beat the system".

Another participant who questioned the efficiency of existing security procedures was Dr. Ware, who said simply: "Nobody knows the kind of threats that will be mounted against data banks. This makes it awkward for the designer of safeguards".

Another security problem arises from the possibility of sabotage. The matter was raised in a question by Prof. Jean Baetz of the University of Montreal. "I would like to know how vulnerable in the present state of affairs are data banks on computers and communications systems - their vulnerability if a substantial segment of people from whom information is sought wished to fool the system. For instance, they could deliberately lie. Suppose a question is asked and you are supposed to reply in one way or another and you reply both ways".

To which Ware said: "I can give you an answer to that question but it won't be a useful answer. The answer is they're terribly vulnerable. But the reason it's not a useful answer is that nobody has really put his mind to trying to figure out how to protect against that kind of mischief. You can invent schemes which give partial protection. For example, suppose you answer a questionnaire for me and you misstate your salary because you think I'm being too nosy. From looking at enough people who I believe are answering honestly, one can get insight into who is misstating the facts". B. B. Goodfellow added his view that systems suffer from "medium vulnerability" to illegal access. "The real problem is that there isn't that great an urgency exhibited to do anything with it. I think we have a lot of ideas of how we could if we had that need".(1)

---

(1) A comprehensive pamphlet, titled The Considerations of Data Security in a Computer Environment, published by International Business Machines Corp., provides additional discussion of security problems.

CHAPTER IV

PROPOSALS FOR ACTION

> "We've seen the offering by various technological specialists in the computer industry of a new world with new possibilities - I hesitate to say brave new world - with many advantages through the use of computers. But many of the offerers are concerned about regulation on the basis of privacy with the apprehension that this will lead to regulation of freedom of speech. I think this is an instance of what Professor Moffat Hancock called the "transplanted category" in which by using a concept developed in one context in a completely different context for which it was not intended, you can give a spurious conclusion certain plausible effect. We should not confuse freedom of speech with the activities of the data manipulators. If we avoid regulation of the new world, the manipulators of information take over under the rubric of freedom of speech. Don't confuse this activity - a controlling activity - with freedom of speech."
>
> - E. F. Ryan
> Ontario Law Reform Commission

Much of the commentary and many of the opinions expressed at the conference suffered from the "transplanted category". The result was, of course, misunderstanding and perhaps, at times, animosity because of a lack of a mutually understood and accepted context. Therefore, before proceeding to examine in detail the various proposals for action, it is worthwhile to review some of the major areas of consensus, either declared or implicit, arising from previous chapters. This will serve as a context for the proposals.

Privacy, a concept not explicitly accepted either socially or in the law, was seen to be an indispensable element of an individual's sense of dignity. And the ability of an individual to preserve his sense of

dignity is vital to the fabric of a democratic society. An individual's privacy, defined perhaps as the desire to be left alone, is constructed on two pillars - the freedom from unwarranted intrusions upon solitude and the freedom from unwarranted manipulation, either threatened or pursued, by those in possession of the means of manipulation. Against the individual's claim to privacy must be weighed the legitimate requirements of the society - maintenance of law and order, operation of the economy, advancement of informed legislation, etc.

Information can be an extremely powerful commodity. Those who are aware of this, many of whom have legitimate requirements for information, often seek information from and about individuals. Individual privacy or dignity may be offended by this process. It may also be offended through the ways in which those who gather information then use it. The power of information is proportional to, among other things, the ability to store, retrieve and analyze it and to correlate it with other information. The harnessing of computer-communications systems to the tasks of storing and manipulating information has incomparably increased the ability to perform these functions. Insofar as these tools exist and are economically feasible, it should be assumed that many information system operators will find it in their interest to use them. A parallel requirement arises therefore, to protect the individual's interest from more intensive privacy invasions that could result if and when certain information system operators come to possess, or control, more powerful bases of information.

Using this general context, the various proposals for action can be divided into two general categories: those designed to protect directly the individual's right to privacy and those designed to circumscribe the

activities of certain operators and users of information systems and the systems themselves. These two categories, of course, reflect two legal approaches to the problems posed by information systems in relation to privacy; the one investing the individual with a right and the other specifically limiting the actions of certain agencies. In seeking to protect an individual's privacy, proposals were made that aimed either at limiting invasions of privacy or at insuring the individual's right of access to information about him held by others. Some participants emphasized the need to regulate the information systems themselves and others saw a need to regulate the actions of both the operators and the users of information systems.

Whichever of these approaches are pursued, the drafters of safeguards should bear in mind Dr. Willis Ware's warning.

> "From the individual's point of view, safeguards have to be credible. They have to look to him as though they're realistic and will, in fact, do as claimed on his behalf, and they have to be understandable. For the lay public, legislation that says a computer must have 'memory protect' and 'privileged mode' and this, that and the other technical feature that some ingenious man has discovered is wrong. First of all, legislation of that kind would be so specific that it's easy to circumvent. It's like the patent business; you can always find a way to get around it. But worse, the general public will not and cannot understand it and therefore it will not be a reassurance. The problem will not have been put to bed."

Rules or regulations have not only to be comprehensible and credible, they should be able to accommodate the inevitable changes brought about by technological advance. Professor Thomas McPhail, supported by Dr. VanderNoot, also pleaded for consideration of the special and increasingly important role of social science research.

"Proponents of legislation severely limiting the rights of researchers", said McPhail, "have to consider the possible spin-offs of legislation. In an era where accelerated change, shifts in living styles and escalation of 'deviant' behavior is the rule, social statistics become almost mandatory if governments and private agencies are to have some yardstick to gauge present programs and, more important, what future societal trends and programs will be like."

1. A Right of Privacy

To protect privacy, one must begin with a definition of the quality to be defended. Attempts usually begin with Article 12 of the United Nations' Universal Declaration of Human Rights.

> "No one shall be subjected to arbitrary interference with his privacy, family, home or correspondents, nor to attacks upon his honor and reputation. Everyone has the right to the protection of the law against such interference or attacks."

By itself, this is of little help in deciding what privacy is. Another suggestion is that privacy is the right "to be left alone". As formulated, such a concept appears to cover at least the major dangers to privacy presented by information systems; i.e., the threat of probes into an individual's activities and the threat posed by those who would use information systems to manipulate individuals. Recall Allan Gotlieb's concept of privacy as the right to disconnect:

> "In the privacy domain, there may be found the desire to be left alone, to be left in peace by the rest of the community, which means the availability of sufficient space to provide protection from the static of one's neighbours, to die alone if one so wished, to rest outside of society, to be non-productive,

> to be off-beat, to be an alien, if one so desired, to turn off the connection. It may also involve respect for one's anonymity in a public place. It may involve being able to establish intimate relationships with others on the understanding that whatever passes between those concerned will not be made public."

Gotlieb also implies that a right to know or freedom of information is a vital prerequisite to the establishing of a right of privacy.

"To what extent is it practicable and feasible to protect the privacy of the individual in a society that looks and behaves more and more like a glorified information system?" he asks. And he cites the spectre of information being held and manipulated by fewer and fewer highly skilled people."

"This increases the danger that the gap between the administrators and the rest of society may widen. The individual may come to feel to an ever increasing extent that he is spied-on in an information-dominated society."

Justice Minister Turner appears to agree for he said: "The rights to privacy and freedom of information are not contradictory but complementary; the right to privacy and the right to know are the twin freedoms indigenous to, and necessary for, the creation of a democratic order."

No matter how these rights are articulated, the real problem is interpreting and enforcing them in specific cases. Willis Ware, for one, seemed content to have an individual's claim to privacy, in the face of conflicting claims, adjudicated by the courts.

> "Suppose a data bank exists and some of that information is used and I don't like it. I sue.

> If I win the case, there is precedent for what is in the individual's best interest and all other operators of data banks take notice. If I lose the case, then I as an individual have to conclude that that class of information has been decided collectively by society and by the legal processes of society to be necessary for the general welfare and benefit of the society. And I must yield."

Unfortunately, this is probably too simple a view. Conference participants raised many questions about how such a right would work. Should for example, there be an "offence" of invasion of privacy and/or a "tort" of invasion of privacy with appropriate remedies, to whom should the right of privacy extend? One workshop pondered how to create a right to privacy for individuals without also passing on that right to corporations or governments. Also, it was recognized by many that invasions of privacy are more likely to create psychological damages than physical damages and that compensation for psychological damages is, to say the least, a hazy legal procedure.

H. Allan Leal of the Ontario Law Reform Commission insisted, however, on the importance of compensating the person who has been damnified. "I'm aware that Westin believes the action for damages is too blunt an instrument to apply where someone has been damnified by some malfunction, personal, mechanical or otherwise. But I think that in addition to your regulatory procedures, standards and penal sanction, this is how you get to the cutting edge of the injury". He was supported by Parkhill, among others, who called for the right to sue for damages if privacy is breached.

Perhaps the most coherent explanation of the inadequacies of establishing a right of privacy was given in a 1968 Report on Protection of

Privacy carried out for the Ontario Law Reform Commission. The report indeed proposed the establishment of both an offence and a tort of privacy but it also argued that, while helpful, these still would not provide adequate protection for the individual.

> "The protection of privacy poses major problems of a social, psychological, economic and ethical nature which are simply non-responsive to attempts to deal with them either in terms of pre-existing legal categories or in any fashion that falls short of being fully comprehensive. If the objective is to grant protection to privacy that is reasonable under the circumstances of any given case, then legislation must not only limit the claim to privacy by this formula, but should also limit those competing claims that are based upon considerations of public interest, economic well-being, commercial expedience, control of anti-social activities and all the rest. Without creating parallel norms, particularly in those areas with either a strong laissez-faire tradition or an established set of distinctive institutional values, then the exceptions inherent in granting protection to privacy that is "reasonable under all the circumstances" may eat up the rule. Loss of privacy, and the resulting decline in the quality of our lives, is really the by-product of hundreds of well-intentioned attempts to come to grips with the major problems of our modern urban-industrial society using advances in technology and streamlined commercial practices to achieve this with a minimum expenditure of time, effort and resources. Controls prompted by the apprehension that the whole of these attempts is unreasonable, but the effectiveness of which depend solely upon a determination of whether any constituent part thereof is by itself unreasonable, appear to the writer to be foredoomed. If we are concerned with the jeopardization of the quality of life, then the scope of our future actions must equal the scope of that which is at stake. The creation of broad spectrum limitations upon the means and the interests that threaten this quality is in fact the substance of the protection of privacy; the mere articulation of a right to privacy, with nothing more, is simply its shadow."

While the Ontario Law Reform Commission argues here that

establishment of a right of privacy might not do much good, many conference participants insisted that it could do a lot of harm, particularly if it went so far as to limit freedom of speech or the right to know. Hugh Lawford of Queen's University, for example, argued that "no legislation should be enacted to protect privacy without legislation to protect freedom of information." And most participants appeared to agree with him. Here is the consensus recorded in the conference summary report:

> "There was almost complete agreement, expressed in ten of the workshops, that there is a need for freedom of access to information. This was regarded as being particularly important with respect to government information. And a Freedom of Information Act, similar to that in effect in the United States, was considered by many to be necessary."

Although the specific question did not arise at the conference, it is worth considering whether a right to information is implicit in a right to privacy. In other words, if it is assumed that part of the right to privacy is the right to "liberate" sensitive personal information held by others, then perhaps an individual could claim damages against an agency attempting to withhold such information in order to blackmail him. Allan Gotlieb, as indicated above, certainly considers this freedom from manipulation to be a vital pre-requisite to privacy. But he also suspects that "the law is powerless to prevent the expanding gap between those who manipulate information and those about whom information is being manipulated."

Whether or not freedom of information is considered an integral component of a right to privacy or a separate right in itself, the same series of questions posed by the Ontario Law Reform Commission above with respect to privacy could apply to it as well. Would the establishment of

a right of privacy or a right of information be adequate to protect against damages done by others exercising legitimate, conflicting rights? In any event, it is likely that Canada will opt for separate legislation to protect the public's right to know. Both Professor Lawford and Justice Minister Turner cited other reasons, not directly related to the privacy consideration, to warrant bringing forth a law to ensure the individual's right to information. Prime among these, it will be recalled, is the idea that citizens need access to government documents in order to play a meaningful role in the process of democratic government. And Justice Minister Turner spoke strongly in favor of the introduction of a Freedom of Information Act.

> "What is necessary is a Freedom of Information Act entitling the individual to information which the government authority has arbitrarily seen fit to withhold. Indeed, as Professor Lawford has pointed out, the Canadian Government has yet to enact a law respecting clearance of, and access to, Government documents. The situation both in respect of access to documents in the national archives as governed by the Public Archives Act, as well as documents still in the possession of government departments, is far from satisfactory. It is true that certain classes of government information may not be disclosed; but the criteria for non-disclosure should be set forth publicly in the statute, this in itself constituting a kind of information about what information is not available; or the right of the public to at least know on what grounds and under what circumstances it may not know. For example, the Freedom of Information Act passed by the U.S. Congress in 1966 and designed to make executive records more accessible to the public, set up eight categories of sensitive information to be exempt from disclosures. These included, *inter alia*, matters such as defence or foreign policy secrets authorized to be kept secret by executive order, etc.
>
> But perhaps the most interesting exemption is that of personnel, medical and similar matters, the

> disclosure of which would constitute a clearly unwarranted invasion of personal privacy. Indeed, the important point about the Freedom of Information Act, and one not entirely appreciated, is that the right to privacy is as much a goal of the Act as the public right to know. For the Act was to provide a basis for safeguarding from disclosure private information about citizens that the government had acquired. The two rights, then, are not contradictory but complementary; they are companion rather than conflicting freedoms; the right to privacy and the right to know are the twin freedoms indigenous to, and necessary for, the creation of a democratic order."

If one is to accept the arguments of the Ontario Law Reform Commission and many others, the relatively simple act of creating individual rights to privacy and freedom of information will not be adequate to protect citizens from privacy invasions in the modern, industrial, urban state. In addition, laws appear necessary to circumscribe the activities of many agencies, individuals and devices that may, accidentally or intentionally, invade personal privacy. A list of such potential invadors would have to include those interested in wiretapping, surveillance devices and so on. The orbit of the Queen's conference, however, was restricted to the field of computers, information systems and the activities of information system operators and users. But that action must be taken on them too was widely recognized. As J. M. Sharp, a panellist and Professor of Law at the University of Manitoba, explained: "There can be no confident self-regulation of input, storage and outflow of data, and the best goodwill in the world of the operators of data banks cannot guarantee security of privacy without legal sanctions to lend 'teeth' to the good intentions."(1)

(1) Sharp's position paper, in effect a detailed blueprint for legislative action, is reproduced in full as Appendix VI.

2. Curbing Misuse and Abuse of Information Systems

> "My concern is that in attempting to regulate the present problems we will develop rules of such generality that we will interfere with systems of the future that aren't subject to these same dangers."
>
> - Hugh Lawford

> "In laying down the rules of the road before the road is used, we can avoid some serious collisions."
>
> - A. E. Gotlieb

As perhaps in any discussion about potential legislative action to curb the activities of certain people and agencies, there were hawks and doves. And the color of one's plumage, as it were, seemed to depend on the extent to which one was afraid that legal measures could interfere with technological development. The dilemma often took on a devastatingly Swiftian air. Lurking behind the apparently calm, reasoned positions of both those who called for broad protective legislation now and those who cautioned against meddling with technology were the implied threats of chaos. And the middle road of common sense, if indeed there is such a road, appeared to be more like a tightrope than a road, upon which it is difficult to stand and even more difficult to stay for any length of time.

B. B. Goodfellow of IBM Canada Ltd. expressed concern at the prospect of "excessive legislation on one narrow element of a broad problem. Standardization inhibits innovation". He was supported by at least one workshop which reported: "There is a real danger in trying to be too broad or sweeping initially. This would almost certainly be interpreted in ways which would inhibit or delay advancement of technology."

For the "hawks", Dr. Willis Ware argued: "I would rather not have data banks become the problem that pollution has become. Thus, my view is that we should vigorously and aggressively formulate appropriate safeguards, mechanisms and legislation. Let's try to be ahead of the situation before it is too late."

Again, the problem of context (or lack of it) is probably largely to blame for this apparent polarization of opinion. It is possible that legislation or regulations can be devised that will adequately protect the public without inhibiting technological innovations. Indeed, it will probably be more difficult to convince people that this can be done than to actually do it.

Take, for example, the simpler of the two aspects of the challenge information systems present; that is, ensuring that the personnel involved are reputable, honest, technically competent, etc. One might expect to find a sharp division of opinion between information system operators and planners as to the need for government action here. In fact, no one denied the need for action. There was some debate on the best way of assuring personnel quality but none on the principle. As Dr. Willis Ware put it: "I want some protection against the possibility that the (operator) is not as honest or careful as I thought he was. I want some legal recourse."

In the debate, Mers Kutt, former president of the Canadian Information Processing Society and Thomas McPhail of Loyola University pleaded the case for self-policing by professional groups.

Kutt, speaking on behalf of computer professionals, said, "the first thing that computer societies should do is educate their members on the

sensitivity of the problem and the rights of the individual to prevent, among other things, the innocent misuse of files. The second thing societies should do is establish professional standards and a code of ethics for computer people involved in information handling activities."

Professor Thomas McPhail, advancing the position of social scientists, suggested that "perhaps the most fundamental (solution) is not to be found in legislation but rather is to be found in the setting of high professional standards for entrance into various social science research disciplines. A practical result of this would be the adoption of some type of code or statement of scientific ethics to be adopted by the various learned societies in Canada." But McPhail also encouraged government action to give teeth to professional ethics. "There are in North America roughly 40,000 social scientists", he said, "it only takes a few who abuse ethical standards to give the profession a bad name."

Those advocating government action were split on how that action should be taken. D. F. Parkhill of the Department of Communications and J. M. Sharp of the University of Manitoba argued that all employees of information system operators should be licensed and bonded. This appeared to have the support of most participants of the conference and there was little discussion one way or another. One thoughtful alternative, however, was presented by John Russell of Systems Dimensions Ltd., Ottawa.

> "Legislators and computer experts alike acknowledge the need to reassure the public of the integrity of the technical insiders who could conceivably gain privileged access to their private files. Towards this end, it has been proposed that computer personnel form a professional association to which a government could delegate regulating responsibilities similar to those delegated to the medical, bar and chartered accountants associations.

> Such an association might be charged with two major responsibilities. The first might be that of establishing professional standards sufficient to inspire public confidence in the capability of data bank systems engineers to build in adequate security controls. The second might be that of maintaining security by controlling employment in the field.
>
> A regulatory association capable of assuming these responsibilities would take many years to mature to a point of effectiveness. In an environment requiring rapid and continuous adaptation to new technology, one might wonder if such an association could ever catch up with the arts and skills being developed by its members.
>
> Since, in the minds of the public, the issue would be one of security rather than professionalism, I would submit that the public interest would be more effectively served through the use of conventional check-outs for the personnel involved. The just application of employability criteria similar to those presently in use in sensitive government and industrial activities should suffice to ensure adequate confidentiality of information."

Proposals of ways to control the information systems themselves were both more numerous and more contentious. Professor J. M. Sharp, for example, suggested that "<u>every</u> data bank should be subject to a licensing requirement regardless of whether it is operated by a government agency, insurance, finance or credit reporting company or other person." Others even suggested that certain kinds of data banks should be outlawed. Obviously wearied by it all, one participant, himself a data bank operator, was nevertheless able to see a bright side. Ian Sharp, president of I.P.Sharp Associates Ltd., Toronto, rose at the end of the final plenary session to comment:

> "With the possibility of Finance Minister Benson's White Paper being translated into law, there could be set up a data bank containing so much information regarding the assets of all individuals in Canada in one form or another that I would like to suggest that any legislation should be phrased in such a way as to make the implementation of such a data bank illegal."

Exactly which data banks should exist and which should be regulated was never settled. One workshop reported "some agreement" that only those data banks containing information "that can potentially harm people" should be regulated. The conference summary report says that "all levels of personal data banks should be licensed but that the degree of licence would vary with the classification of the information contained."

Having established through some means, such as Professor C. C. Gotlieb's classification system, which information systems require surveillance in the public interest, the next problem is to discover how to provide a useful, adequate and credible surveillance. Again, Dr. Willis Ware provides a full list of the information he would want to have on data bank operations, were he a regulator.

> "Before an owner and operator of a data bank could be licensed, so to speak, I would ask that he demonstrate to an appropriate regulatory body such things as the following:
>
> * the nature and purposes of his data bank; the use to which the data will be put; and the general class of customers it will serve,
>
> * precise identification and description of the data sources on which it will draw, and the checks that will be applied to validate the information from the sources,
>
> * a complete description of the safeguards of the system (physical, hardware, software, communication, personnel and administrative/management) that protect information and control its divulgence,
>
> * a complete description of the procedural safeguards (software or manual) to edit source information for errors, to assure posting information to correct dossiers, to resolve ambiguity in identification of an individual, to treat information of doubtful validity and to establish confidence levels on information derived or inferred from fragmentary data,

* a complete description of the audit processes incorporated in the system, and the audit information that will be made available for periodic review,

* the mechanism whereby an individual can review his dossier and the sources from which the dossier was compiled, and challenge its contents and correct errors,

* the tests and inspections that he has performed on the system to assure that it does operate properly, and especially that the software has been verified completely designed."

Ware also explained why data bank operators should be obliged to fulfill these requirements, requirements that he willingly admits are stringent. "I would rather begin too strongly", he said, "and weaken controls as experience shows it possible than recover from awkward oversights after the fact." Some of his suggested requirements, such as means of validating source data and security measures taken in and around the data bank are obviously important but others, although less obvious, could be equally important.

Consider for example, some potential problems that can arise with users Ware argued that the operator must accept prime responsibility for certifying that his users are as they represent themselves and to keep others out. Then, "the provisions of communications' secrecy acts would seem to be applicable since users will receive information as a privileged communiqué and should therefore be liable for willful or negligent transfer to other parties."

If one of the users is another data bank, Ware would call for additional safeguards on the operator's part. "Audit trails must be maintained so that he knows where copies of any or all parts of data exist in computer files, and he must accept responsibility for updating or correcting such copies promptly and responsively. Conversely, if he receives data from another data

bank, he must keep audit information so that original sources can be identified at a later date. This could be crucial in the event of damage suits in which the operator's liability should be shared with data sources." Willis Ware argued that the existing societal process of legislation as interpreted by the courts can function to establish the precise details of an individual's claim to privacy.

Once a regulatory authority has established the kind of information it needs in order to perform its function, it must then establish sets of minimum requirements for various categories of data bank operations to meet and penalties to impose in cases of failure to meet them. To judge from the conference discussions, people are particularly concerned, even anxious about the data gathering, verifying and distributing functions of some data bank operations. Professor J. M. Sharp, for example, explored some of the dangers that can arise in linking two data banks and called for "close scrutiny" of this practice.

> "The greatest importance of this type of scrutiny would be in relation to data banks with international links. It has been suggested, and the writer concurs, that the total effect of a drain of personal, commercial and even governmental data from Canada to foreign countries could be the creation of a serious threat to the Canadian economy, and a violation of Canadian sovereignty none the less real by reason of the fact that it is an intangible, "invisible" violation.
>
> Regulation of inter-memory bank links between provinces is only fractionally less crucial, for the entirety of the data in one bank which has drawn on many sources takes on a manifestly greater significance than the sum of the contributions of the various original constituent sources.
>
> Even <u>within</u> provinces, particularly the larger, more "commercialized" ones, the same problem arises; an intra-provincially linked, but not externally-linked, system should be subjected to provincial regulations along similar lines. Here, again, the need for uniform provincial legislation is apparent.

> The related topic of sales of information by data bank operators must be considered. A recent press report states that a U.S. data system went out of business and proceeded to sell dossiers on three million individuals, as a company asset, to the highest bidders. It is scandalous that information, perhaps volunteered by an individual for a specific, limited purpose, and perhaps of a highly confidential nature, should find its way into the public market to be hawked around as if it were clearance stock.
>
> It is strongly suggested that the dual type of links between data banks, and output therefrom, should be regulated closely, even, perhaps, to the extent of legislating some new concept of "qualified property" in both the physical computer tapes, cards, etc., and in the intangible information which stems from these sources. The existing case law in this area is at present inadequate and is unlikely to develop either quickly or fully through new judicial decisions."

Claude-Armand Sheppard argued in his position paper that "data furnished by citizens to any government department or official agency at any level should not be available to any other department or agency at any level or to any outside source". He also would simply forbid the constitution of large pools of data either in government or in private hands and would "prohibit the recording in data banks, except for purely statistical purposes, of any reference to, or indications of, an individual's ethnic origin, religious beliefs or political opinions."

Parkhill demanded "recognition that the individual named in a file is the ultimate owner of that file and, consequently, has the sole right to determine the persons to whom access is to be granted." He also suggested improperly authorized access to an individual's file should be a serious crime punishable under the criminal code by severe penalties.

As for collection and verification of data, one finds proposals for

elaborate mechanisms for people to be able to check personal information held in data banks, for forbidding storage of unverified information obtained by interviewing neighbors and for establishing cut-off dates in advance for certain types of information.

Parkhill suggested that it should be "the responsibility of the data bank organization to provide each individual named in that bank with a monthly statement of the contents of his file, the names of those people and organizations who have been granted access and the purpose and authority for such access." A clause to this effect is also contained in Tim Reid's data bank bill before the Ontario legislature.

Parkhill also suggested that "every person have the right to inspect his file at any time, to question its contents and, where disputes arise, to order the offending entries deleted until such time as the data bank operator can demonstrate their accuracy before an independent tribunal."

The point of the right to review was also mentioned in several workshop reports, indicating that this is a major area of grievance.

Professor Sharp acknowledged, however, some restrictions on this proposed right. "The process could be expensive; in this case, charge the individual a realistic fee. This would not only avoid undue expense to the operator, but also deter frivolous or spurious requests."

Pearson of the Associated Credit Bureaus of Canada vigorously opposed the suggestion that data bank operators should send a print-out to each individual on a monthly basis reporting uses of his file. He claimed the U.S. government had backed away from installing such a requirement,

realizing that it would be prohibitively expensive. One workshop noted that "no regular reporting should be necessary since the individual should have access to his file and he knows that the file exists at a specific location." But another workshop cautioned that "there might be 'inequalities of access' due to individuals' differing economic situations." Pearson also claimed that most people don't want to see their credit record because they know it is good and they don't want the information flowing through the mails.

One reason for the high degree of accuracy of information held by private agencies, such as credit bureaus, advanced by one participant is the existence of competition. There is a natural check on accuracy, he said, when the information selling business is competitive. He suggested that greater attention should be paid to scrutinizing situations in which no competition exists.

Professor Sharp argued that cut-off dates should apply to certain facts stored in information systems after the lapse of pre-established periods of time. And he noted the practice of the Associated Credit Bureaus Inc. of Houston, Texas of not reporting bankruptcies longer than 14 years from the date of adjudication of the most recent bankruptcy nor recording accounts placed for collection longer than seven years. "While it may be argued", Sharp said, "that cut-off dates should not be applied to certain governmental data banks (e.g. any data bank or portion of memory bank controlled by the Dominion Bureau of Statistics which would separate identities and information before public release), it has been widely accepted that, in the interests of protecting privacy and with no substantial impairment of freedom of information, cut-off dates should apply to certain facts after the lapse of given periods of time."

To expedite the process, Ware suggests that "the individual probably should have a legal, court-created document certifying that some action has been taken. Consider the person who has been arrested and accused of a felony," he said. "Later, however, he is acquitted. This fact may well find its way into his credit reference file and he should have some positive confirmation from the data bank that his arrest experience has been expunged from all copies of his credit file." (1)

Finally, both B. B. Goodfellow and John M. Russell offered potential law - or regulation-markers some technical advice. Goodfellow observed that:

> "There is less security consideration on defence systems - and needs to be - than there is on other systems. And the reason for this is that defence systems are so protected by a host of other things like the surveillance of all the people and barbed wire fences and the like. You actually should, and in most cases they do, build more security into, for example, one of the state's Blue Cross data banks than they would into some of the defence systems."

Still on security questions, John Russell pointed out that the administration of passwords and other authorizing instruments is a costly and time-consuming function which cannot be hurried. "Draftsmen of legislation should therefore provide adequate statutory time delays between the application and the granting of authority to access a data bank."

3. Vehicles of Action

The most common suggestion was to establish a regulatory agency with responsibility for information systems of specified types and provide it with

(1) There is a self-defeating feature in this proposal - that is, the data bank, for its own protection, would have to keep a record of its "positive confirmation" to the person.

licensing powers. There was little discussion as to whether the same agency might have powers over both information systems and their operators or whether there should be two agencies. There was, however, considerable emphasis on the necessity for government-operated information systems - some would even include police files - to be subject to the scrutiny of the regulatory authority. Some doubted this would work. "How can we expect one government agency to provide impartial and credible surveillance over another?", one participant asked rhetorically. There are, of course, several instances of this happening in Canada, but perhaps they provoked the remark!

An argument against licensing (although not against government regulation) was presented by A. E. Ende of the U.S. Federal Communications Commission in one of the workshop sessions. He argued instead in favor of setting standards and policing them. He said that licensing tends to be based on criteria taken from past experience which may no longer be relevant. Once embedded, however, these criteria are difficult to throw out. Also, licensees become very tenacious about their licences, he argued. By establishing standards only, these can be modified as required and published. Anyone who doesn't meet the standards is punished. Finally, Ende pointed out that licensing is perhaps a useful tool where a government is awarding franchises for the use of limited resources (e.g. broadcasting frequencies) but this does not applv in the case of data banks.

In addition, the idea of setting up a body to oversee the regulation process was extremely popular. Six of the workshop groups discussed the possibility of establishing an office of an ombudsman or a commission or tribunal with limited authority. Its function would be to recommend appropriate

regulation or legislation but it would have neither regulatory nor legislative powers. It could also hear cases of specific injuries resulting from information systems, conduct research into data bank developments, recommend data classifications, review professional standards, etc. Proposals like this appear to represent the general feeling of a need for an advisory body at arm's length from any regulatory or legislative authority. Some people, for example, suggested it should include representatives from various groups in both the private and public sectors.

4. A Note on Legislative Competence

Professor J. M. Sharp argued the case for federal jurisdiction over information systems, mainly on the following grounds. "I can envisage nothing more unsavory or undesirable than that a given province should become the Las Vegas of the computing industry because, while the others have regulated, this one attracts the Panama flag of convenience of the computer industry. And this I think could quite easily happen unless we have a federal assumption of jurisdiction."

In Sharp's view, "at least those computers and data banks which participate in inter-provincial or international flows of credit,commercial or other information would seem to be pre-eminent candidates for federal legislation."

For constitutional support, he referred to the "stream of commerce" doctrine, the telecommunications analogy as expressed in the Telesat Canada Act, 1969, and the criminal law and national security. He admits, however, that for intra-provincial systems, "provincial legislation (ideally in the

form of a uniform statute) would be needed. Perhaps a rather loose analogy could be drawn from the inter-relation of the federal Narcotic Control Act and Food and Drugs Act on the one hand and the provincial Pharmaceutical Acts on the other hand. To some extent these are complementary; there is no reason why an interlocking system of federal-provincial legislation should not be evolved to deal with data banks and the information they store."

Professor Douglas A. Schmeiser of the University of Saskatchewan College of Law and Chairman of the panel session on legal and regulatory means of reaching objectives, finds "the arguments in favor of federal jurisdiction over the basic area of privacy are not really very compelling." But neither he nor Claude-Armand Sheppard, who agrees with him, elaborated on their views.

Sheppard did say, however, that "the constitutional aspects of legal controls over data banks are not as intricate as they might appear. It seems highly doubtful to me that the federal government could lay claim to exclusive jurisdiction. In all probability, and in the good old schizophrenic Canadian tradition, jurisdiction is shared between Ottawa and the provinces."

5. International Considerations

In some senses, the argument over legislative competence within Canada may be a meaningless exercise, for it was recognized at the conference that the "Las Vegas" of the Canadian data bank business could well be Las Vegas itself. Because of the numerous, open telecommunications circuits connecting Canada and the U.S., it is virtually impossible to stop a data flow across the border if data bank operators want to organize their affairs

in that direction. Canadian laws may insist that data on Canadians be stored in Canada, as some conference participants urged, but it would appear difficult to stop anyone determined to store copies of that data in the U.S. if he wished to do so.

Therefore, as others suggested, notably Guy Braibant of the French Conseil d'Etat, avenues of international co-operation should be explored. As Braibant put it: "If certain countries adopt severe legislation and others do not, with the developments in data communications we run the risk of having data bank havens in certain countries. I think that during the next decade the United Nations without doubt will have to study the creation of international agreements in this area as it has done in the area of telecommunications."

International action does not, of course, obviate the need for domestic action. If Canada doesn't take action internally, regardless of the success of international negotiations, the country could well become one of the data bank havens Braibant speaks of!

6. Conclusion

Seven of the twelve workshop reports call for the establishment of a task force to begin studying possible legislative action. Some called for a federal-provincial study group, others wanted representation on the tak force from the public and private sectors. One even eschewed the idea of a task force in favor of "a small, working group" to study carefully the many questions raised at the conference.

Perhaps these proposals are the best measure of the extent of the

belief that action is urgently required. And that would appear to reflect agreement with A. E. Gotlieb when he said in his position paper:

> "The gap between technological development and legal regulation cannot be permitted to widen and must quickly and decisively begin to close. Government at the federal, provincial and municipal levels, law associations, universities, scientists, scholars and all concerned individuals have the responsibility to propose solutions designed to recognize and protect the needs of the individual in the new society which the computer and telecommunications promise to bring about."

APPENDIX "A"

Definition of Privacy

All workshops discussed the concept of privacy, except one which did not do so explicitly. Almost unanimous agreement was reached to the effect that privacy should receive increased protection, although not necessarily on an unconditional basis.

Most workshops had difficulty in trying to define the concept of privacy and several referred to the necessity of elucidating the notion of privacy as a legal concept, or indeed to elaborate on a philosophy of privacy. Some workshops doubted that this could be done except on an ad-hoc basis and others felt the concept varied with the historical or social circumstances and should be left to the courts.

Again, others reached the conclusion, that the right to privacy should be expressed in the law and that it should be in accordance with the Universal Declaration of Human Rights.

There was a marked difference of opinion on the questions whether computers were relevant to the issue of privacy. Some thought that computers have a direct impact on privacy -- others that computers have nothing to do with privacy of freedom and others that computers are relevant to the extent that they magnify the problem.

Finally, the opinion was expressed that privacy should not be confined to computer-based systems.

Freedom of Access of Information

The right to privacy has to be balanced by two other requirements. It was generally recognized that there were needs for data banks arising out of the needs for planning, research and commerce.

Further there was almost complete agreement, expressed in ten of the workshops, that there is a need for freedom of access to information. This was regarded as being particularly important with respect to government information, and a Freedom of Information Act, similar to that in effect in the United States, was considered by many to be necessary.

Technical Aspects - Impact of Computers on Privacy

There was a division of opinion as to whether or not computers had a direct relationship to invasion of privacy. The predominant opinion was that the computer by permitting faster searching of more comprehensive files has indeed changed the quality of the privacy problem. The computer, however, does present the possibility of implementing more effective security controls than possible in a manual system.

Although some papers implied a high degree of security in multi-user communications oriented computer utilities, it was felt that the state-of-the-art was not adequate to handled such systems. The level of security protection needs to be appropriate to the type of data in a data bank, and this might be best achieved by using separate systems for different types of data banks. Aside from the security problem, it is not regarded as presently technically feasible to implement a national data bank on a single system. A network of computers might be possible for the purpose.

Task Force

Seven groups recommended that a task force be set up in one form or another. Three refer specifically to a Federal-Provincial Task Force, while one suggests representation by lawyers, computer

specialists, social scientists, business, government and education. Suggestions for its tasks include a review of present practices and laws, a survey of current levels of dissemination of personal data, the identification of specific areas of concern, a definition for concepts such as privacy, data banks and information systems, a study of the constitutional issues and the recommendation of guidelines and new legislation. A number of groups stressed that such a task force should be set up as soon as possible.

Commission-Tribunal-Ombudsman

This concept, in varied forms, was mentioned by six workshops. The body would have neither regulatory nor legislative powers but could recommend appropriate regulation or legislation.

Some suggested functions:

- consider specific injuries from misuse of information
- advise on potential data bank development; conduct research into data classifications
- adjudicate complaints
- establish professional standards; examine types of information being stored and uses to which it is being put
- license data banks; require periodic reports on systems procedures by operators; require prior approval for interchange or collation of information between different systems.

Proposals made for both federal and provincial ombudsmen. uggested Commission or Tribunal should be fed-prov, include reps from ndustry (one proposal that majority of members be from private sector), niversities and groups such as civil liberties and consumer associations. ote: The Commission or Tribunal is also seen as an interim measure oward legislation, as a substitute for it, or as an adjunct to a Task orce Investigation.

Professional Licensing and Registration

Almost all workshop groups recommended that some form of licensing and registration was required. This requirement was necessary for control purposes and not for the sake of licensing per-se. Licensing should identify the type of data bank and should be administer by an independent body. It was suggested that all levels of personal data banks should be licensed but that the degree of license would vary with respect to the classification of the information contained. In this regard it was noted that a person could be identified even though his name did not appear in the record.

One workshop suggested that licensing of data banks, that were remotely accessed, was necessary, as the security problems, associated with time sharing have not yet been solved.

Another workshop posed the following questions:

- is licensing desirable?
- who should be licensed - investigators
  - owners of data banks
  - programmers?

In general people should be licensed for ethical activity

Legislation and Regulations

Four workshops made no specific suggestions for legislati although the fact of their being legislation in respect of privacy was assumed by one of the workshops to the extent of establishing a regulatory authority at least.

Seven workshops made specific suggestions for legislation of the "Bikini" type, as defined in one workshop, that is legislation to cover the essential points. These essential points appeared to be among the following:

a. the protection of the privacy of individuals (6 out of the 7).

b. this protection was by way of establishing a civil liability for damages in three cases, while a criminal liability was inferred from the suggestion of one workshop, in addition to a civil remedy.

c. a right of privacy to be provided in accord with the Declaration of Human Rights was suggested in two of these workshops.

d. individual's review of any file on him to be a matter of right (two workshops).

e. the access of an individual to his file to be controlled by him (two workshops).

This group had two workshops suggest that the legislation should be of the type that would permit experience to be gained from which the necessity of further legislation could be more knowledgably determined. One suggested that this essential legislation was urgent. Two workshops in this group were interested in legislation providing more freedom of access to government information.

Other matters of legislation touched upon by these groups were that legislative rules should apply equally to government files as well as to others and that the information required in the public interest should be clearly set out in legislation as well as to whom it can be released. One workshop of this group suggested that federal legislation was require because of the "haven" problem and the mobility of data.

Workshop number three dealt with legislative proposals at length, and although some of their points were covered by other workshops it is felt that its report is better referred to than summarized.

In the result all but four workshops out of twelve recommended some form of legislation. No workshop appears to have recorded opposition to legislation and one even suggested that some legislation was needed as soon as possible, but cautioned about proceeding on insufficient information.

Penalties

Eight workshops suggested that penalties should be created for misuse or negligence in the use of information. Six of them distinguished between criminal and civil penalties. In the latter case, misuse of information should give rise to action in damages.

It was also felt by one workshop that the transfer of information from one data bank to another should be prohibited. It was suggested by one other workshop that a public fund be created to indemnify personal loss where litigation is not a practical remedy.

Several comments were made about government's role as a major data gatherer.

-- not enough attention was paid to government's computerized files; that any regulatory body should be independent of government because government is the owner of such large systems; that, excluding national security, government should be subject to any controls adopted.

-- In two workshops the opinion was expressed that even police systems should be included.

International Issues

Three workshops expressed concern that legislation should ensure Canadian control of data banks especially when they contain personal information about Canadians. One group felt that avenues of international cooperation providing for the protection of individual privacy should be explored.

APPENDIX "B"

Panelists and Speakers

Panel 1

Privacy and Openness as Social and Legal Concepts

Chairman	Dr. John J. Deutsch Principal and Vice-chancellor Queen's University
	Mr. A.E. Gotlieb Deputy Minister Department of Communications Ottawa
	Me Claude-Armand Sheppard Etude Robinson, Sheppard Drymer et Shapiro Montréal
	Hon. John Turner Minister of Justice Ottawa

Panel 2

Data Banks: Existing Technology and Practice

Chairman	Prof. Jacques Saint-Pierre Directeur du Centre de Calcul University of Montreal
	Mr. R.F. Linden Department of Industry, Trade and Commerce Ottawa
	Dr. T.J. Vander Noot Associate Director General Operations and Systems Development Branch Dominion Bureau of Statistics, Ottawa
	Mr. M.T. Pearson General Manager Associated Credit Bureaus of Canada

Panel 3

Data Banks: Direction of Development Resulting from Needs and Technology

Chairman
Dr. Louis Robichaud
Directeur
Centre de traitement de l'information
Laval University

Mr. D.F. Parkhill
Director-General
Policy, Plans and Programs
Department of Communications, Ottawa

Mr. B.B. Goodfellow
Director
IBM Canada Laboratories

Dr. Willis H. Ware
The Rand Corporation
Santa Monica, California

Guest Speaker

Hon. Eric Kierans
Minister of Communications

Panel 4

Objectives for Securing Privacy and Freedom of Information in Data Banks

Chairman
Mr. T.B. Smith
Advisory and International
Law Section
Department of Justice, Ottawa

Prof. Calvin C. Gotlieb
Director
Institute of Computer Science
University of Toronto

Prof. Hugh Lawford
Department of Law
Queen's University

Prof. Thomas L. McPhail
Co-chairman
Department of Communications
Arts
Loyola College

Panel 5

Professional and Technical Means of Reaching Objectives

Chairman
Me Guy Houle
Services juridiques
Bell Canada

Mr. Mers Kutt
President
Consolidated Computer Services Ltd.

Mr. David F. Booth
I.P. Sharp Associates Ltd.

Mr. J.M. Russell
Vice-president
Research and Development
Systems Dimensions Ltd.

Panel 6

Legal and Regulatory Means of Reaching Objectives

Chairman
Prof. Douglas A. Schmeiser
College of Law
University of Saskatchewan

Dr. Paul Armer
Director, Computation Center
Stanford University

Me Claude Frenette
Vice-president
Power Corporation of Canada Limited

Prof. J.M. Sharp
Legal Research Institute
Faculty of Law
University of Manitoba

Final Session

Guidelines

Chairman
Me Jean Beetz
Doyen de la Faculté de Droit
University of Montreal

Rapporteurs
Yves Legris
Department of Communications

Leslie Meizi
University of Toronto

Conference Committee

Conference Chairman	Richard Gwyn Department of Communications
Programme Chairman	Calvin C. Gotlieb University of Toronto
Members	J. Ryan Department of Justice
	J. Crowson Department of Communications
	D. Booth I.P. Sharp Associates Ltd.
Arrangements Chairman	Hugh Lawford Queen's University

APPENDIX "C"

P A R T I C I P A N T S

ABBEY Dr. D.S.
Ontario Institute for Studies in Education
Toronto

ADAMEK P.
Bank of Canada
Ottawa

ALBRECHT L.K.
Royal Insurance Group
Toronto

ALLEN R.E.
Canadian Pacific Railways
Montreal

AMEY Dr. G.X.
Defence Research Board
Ottawa

ANDERSON M.F.
Simpsons-Sears Limited
Toronto

BALMER D.
Canadian Bankers Association
Toronto

BAUDOT J.
Centre de Calcul
University of Montreal

BAXTER Dr. D.C.
Department of Supply & Services
Ottawa

BEAVIS D.B.
Privy Council Office
Ottawa

BEETZ J.
Faculté de Droit
University of Montreal

BEEZLEY J.A.
External Affairs
Ottawa

BENETEAU B.A.
Québec - Téléphone
Rimouski

BERGERON G.
Department of Communications
Ottawa

BONYUN Prof. D.A.
Computing Centre
Acadia University

BOUWMAN R.J.
B.C. Telephone Company
Vancouver

BOWKER W.
Institute of Law, Research and Reform
University of Alberta

BRAIBANT G.
Conseil d'Etat
France

BRAZEAU J.
Centre de Sondage
University of Montreal

BOOTH D.F.
I.P. Sharp Associates
Ottawa

BROWN C.
Leader of the Opposition Office
Ontario Government
Toronto

BRYSON G.
Alphatext Systems Limited
Ottawa

BURGER A.F.
Department of Finance
Ottawa

URNHAM M. Elizabeth
he T. Eaton Company Limited
oronto

UTTERFIELD F.J.
anadian National Telecommunications
oronto

ARON Y.
ontreal

ARROLL J.M.
omputer Science Department
niversity of Western Ontario

ARSS T.O.
ell Canada
ontreal

HARLES W.H.
aw School
alhousie University

HEETHAM A.
ntario Credit Union League Ltd.
oronto

LENNETT M.C.
he Royal Bank of Canada
ontreal

LERMONT M.
anque Canadienne Nationale
ontréal

OOKE Susan
redit Granters Association of Canada
oronto

OOTE G.F.
omputer Data Processing Ltd.
algary

OSTA J.P.
élégation à l'informatique
onseil d'Etat, France

OTLER I.
epartment of Justice
ttawa

CROWSON J.S.
Department of Communications
Ottawa

DARLING P.A.
Computing Centre
University of Victoria

DESJARDINS Alice
Privy Council Office
Ottawa

DEUTSCH Dr. J.J.
Principal and Vice-Chancellor
Queen's University

DOLAN F.J.
Data Centre
University of Calgary

DORION Judge G.
Régie des services publics
Québec

ENDE A.H.
Federal Communications Commission
U.S.A.

FIELD F.W.
Bell Canada
Montreal

FIERHELLER G.A.
Systems Dimensions Limited
Ottawa

FORGET G.
Centre de documentation
Laval University

FOX R.G.
Centre of Criminology
University of Toronto

FREEDMAN H.A.
Dominion Bureau of Statistics
Ottawa

FUNK J.A.
Saskatchewan Telecommunications
Regina

GARDNER Capt. M.T.
Canadian Forces Headquarters
Ottawa

GALLOUEDEC-GENUYS F.
Centre national de la
recherche scientifique
Paris

GIRARD J.R.
Department of Eduction
Quebec

GLINSKI G.S.
Electrical Engineering Department
University of Ottawa

GORDON H.P.
Lawyer
Montreal

GRAHAM Prof. J.W.
Computing Centre
University of Waterloo

GOODFELLOW B.B.
IBM Canada Limited
Toronto

GOTLIEB A.E.
Deputy Minister of Communications
Ottawa

GOTLIEB Prof. C.C.
Institute of Computer Science
University of Toronto

GUTHRIE A.D.
Lawyer
Montreal

GWYN R.
Department of Communications
Ottawa

HANSEN B.
Committee of Presidents of
the Universities of Ontario
Toronto

HOLMLUND B.A.
Department of Computational Science
University of Saskatchewan

HARVEY L.
Control Data Canada Limited
Montreal

HAYES R.D.
Department of Justice
Ottawa

HEAP F.K.
Department of Supply & Services
Ottawa

HEENAN T.F.
B.C. Telephone Company
Vancouver

HILTON D.A.
Department of Communications
Ottawa

HOFLEY B.C.
Department of the Solicitor
General
Ottawa

HOULE G.
Bell Canada
Montreal

HUGHES C.J.
Department of Mathematics
University of Ottawa

HOWARD F.E.
Department of Communications
Ottawa

IRONSIDE Diana J.
The Ontario Institute for
Studies in Education
Toronto

IEVERS Miss Florence
Department of Communications
Ottawa

IRWIN J.W.
Retail Council of Canada
Toronto

JONES R.H.
Royal Canadian Mounted Police
Ottawa

JENKINS W.
Computer Centre
Queen's University

KATZ L.
Physics Department
University of Saskatchewan

KAUFMAN Dr. H.
Science Council of Canada
Ottawa

KEECH Dr. G.L.
Data-Processing Computing Centre
McMaster University

KENNEDY G.H.
Retail Credit Company of Canada Ltd.
Toronto

KIERANS Honorable E.
Minister of Communications
Ottawa

KING E.E.R.
Department of Communications
Ottawa

KINGSBURY L.D.
Imperial Oil Limited
Toronto

KOLTAI S.K.
Department of Treasury & Economics
Toronto

KUTT M.
Consolidated Computer Services Ltd.
Toronto

LAWFORD Prof. H.
Faculty of Law
Queen's University

LEAL H.Allan
Ontario Law Reform Commission
Toronto

LEDERMAN Prof. W.R.
Faculty of Law
Queen's University

LEGARE J.
Department de démographie
University of Montreal

LEGRIS Y.
Department of Communications
Ottawa

LIEBEL P.
Department of Communications
Ottawa

LINDEN R.F.
Department of Industry, Trade
and Commerce
Ottawa

LATTA K.
Faculty of Law
Queen's University

MACDONALD Dr. J.B.
Committee of Presidents of
Universities of Ontario
Toronto

MACNUTT J.
Department of Development
P.E.I.

MANNING E.G.
Computer Science Department
University of Waterloo

MARSH A.
Ecole de bibliothécaires
University of Ottawa

MASSICOTTE J.
Department of Communications
Ottawa

MCCLUNG M.
Secretary of State Department
Ottawa

MCGEE C.E.
Department of Communications
Ottawa

MCINNES G.A.
Alphatext Systems Limited
Ottawa

MCPHAIL Prof. T.L.
Department of Communication Arts
Loyola College of Montreal

MEZEI Prof. L.
Department of Computer Science
University of Toronto

MILNE J.D.
The Canada Life Assurance Company
Toronto

MURRAY G.G.
IBM Canada Limited
Toronto

O'CONNELL B.P.
Research Department
McMaster University

OGILVIE J.C.
Department of Psychology
University of Toronto

OLSON E.R.
Department of Justice
Ottawa

O'REILLY B.
Department of Communications
Ottawa

PATENAUDE P.
Faculté de Droit
Université de Sherbrooke

PATTERSON Z.R.
Ontario Department of Education
Toronto

PEARSON M.T.
Associated Credit Bureaus of Canada
Toronto

PHARAND D.
Faculté de Droit
University of Ottawa

POLLARD W.L.
London Life Insurance Company
London

POUNDER D.W.
Systems Dimensions Limited
Ottawa

RAYCRAFT G.J.
Ontario Credit Union League Limi
Toronto

REIMAN R.I.
Treasury Board
Government of Ontario
Toronto

RIBLER Dr. R.
Computer Sciences Canada Limited
Toronto

RICHARDSON L.E.
T-Scan Limited
Toronto

ROBB J.A.
Lawyer
Montreal

ROBICHAUD Dr. P.H.
Centre de Calcul
Laval University

ROBINSON Dr. P.
Department of Agriculture
Ottawa

ROBSON Dr. R.A.H.
Department of Sociology &
Anthropology
University of British Columbia

RODGERS I.
Financial Post
Toronto

RUSSELL J.M.
Systems Dimensions Limited
Ottawa

RYAN E.F.
Ontario Law Reform Commission
Toronto

RYAN J.W.
Department of Justice
Ottawa

CHMEISER Prof. D.A.
ollege of Law
niversity of Saskatchewan

CHNAITH R.A.
nivac
t. Paul, Minnesota

COTT D.B.
epartment of Computing Science
niversity of Alberta

EAMAN A.E.
epartment of Communications
ttawa

EDGWICK G.G.
awyer
oronto

HARP I.P.
.P. Sharp Associates
oronto

HARP Prof. J.M.
aculty of Law
niversity of Manitoba

HEPPARD C.A.
vocat
ontreal

KELLY Dr. S.
epartment of Attorney General
innipeg

MITH T.B.
epartment of Justice
ttawa

OBERMAN DEAN D.A.
aw Faculty
ueen's University

PEIGHT J.A.
omputech Consulting
ancouver

PICER E.J.
ibrary of Parliament
ttawa

STEWART Gail
Economic Council of Canada
Ottawa

ST-PIERRE Prof. J.
Centre de Calcul
University of Montreal

TANNOCK B.W.
Shell Canada Limited
Toronto

TAPSELL J.E.
IBM Canada Limited
Toronto

TATEISHI A.T.
Department of Supply & Services
Ottawa

TAYLOR G.F.
Bell Canada
Montreal

TELLIER P.M.
Bureau du Conseil Privé
Ottawa

THOMAS U.
OECD Secretariat
France

THOMSON G.M.
Royal Canadian Mounted Police
Ottawa

THOMPSON G.B.
Northern Electric Company
Ottawa

TRUDEL J.P.
Commission des écoles catholiques
de Montréal

TURNER Honorable John
Minister of Justice
Ottawa

VANDER NOOT Dr. T.J.
Dominion Bureau of Statistics
Ottawa

WARE Dr. W.H.
The Rand Corporation
U.S.A.

WARREN R.G.
Department of Communications
Ottawa

WILLIAMS I.
Department of Sociology
University of Western Ontario

WILLIAMSON D.
Alberta Government Telephones
Edmonton

WILSON Helen
Department of Communications
Ottawa

YEOMANS D.R.
Department of Supply & Services
Ottawa

ZEAMAN Z.
CRESIGU
Montreal

TELECOMMISSION

Study 5(f)

Institutional Arrangements for Optimizing Developments of Databanks in the Public Interest

The Department of Communications

Study 5F

"Institutional Arrangements for Optimizing

Developments of the Data Banks in the Public Interest"

Available by mail from Information Canada, Ottawa,
and at the following Information Canada bookshops:

HALIFAX
1735 Barrington Street

MONTREAL
1182 St. Catherine Street West

OTTAWA
171 Slater Street

TORONTO
221 Yonge Street

WINNIPEG
393 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

Price $1.75 Catalogue No. Co41-1/5F

Price subject to change without notice

Information Canada
Ottawa, 1971

This Report was prepared for the Department of Communications by a project team made up of representatives from various organizations and does not necessarily represent the views of the Department or of the federal Government, and no commitment for future action should be inferred from the recommendations of the participants.

This Report is to be considered as a background working paper and no effort has been made to edit it for uniformity of terminology with other studies.

Table of Contents

"Institutional Arrangements for Optimizing Development of Data Banks in the Public Interest"

Section I

Summary

General

This report results from a study of information needs and the means of satisfying them in six distinct sectors of the activities of Canadians. The study is one of a series of Telecommission Studies announced by the Honourable, The Minister of Communications on September 18, 1969. It is related to Study 5(a) which deals with: the relationships between common carriers, computing companies, and information and data systems; concept of computer utility; long term market prospects for computer services; and telecommunications services - present and anticipated needs of the computer industry and its customers. It can also contribute to the continuing work of the Canadian Computer Communications Task Force.

Project Team

The project team included 18 members drawn from government and the public at large. Two officers from the department were designated as liaison officers. The names of the members and their affiliations are included in this report as Exhibit II. They were well fitted to investigate those sectors of Canadian activity which eventually formed the parameters for this study. Unfortunately, the magnitude of the undertaking was not fully appreciated until investigations were well underway and it then became apparent that the study was too demanding of time and facilities to permit the original objectives to be obtained and the terms of reference to be fully met.

* The Telecommission, announced by Communications Minister, Eric Kierans, on September 18, 1969, is a comprehensive inquiry into telecommunications and comprisies some 50 separate studies into aspects such as market prospects, regulation, interconnection wide-band distribution systems, technological possibilities, social environment, etc.

Objective, Terms of Reference

The general objectives and terms of reference were established by the general agreement of a majority of the project team members and the liaison officers. The general objectives were set out as follows:

> "To identify national information services in the public interest which could be supplied by large remote access data banks and to develop and analyse possible institutional arrangements for their development, implementation and operation."

To these were appended specific terms of reference. A statement of the objectives and the specific terms of reference including explanatory notes is included in this report as Exhibit No. I.

Observations

That the objectives were not fully achieved and the terms of reference not fully met becomes of less consequence when the results of the study are fully evaluated. The work done emphasizes the magnitude and importance of the field. It highlights the importance of systems evolved being on a national basis if maximum usage at minimum cost is to be achieved.

The study group concurred in the concept that information is a vital resource which is as important to productivity as land, labour, capital and management. The group believes that the quality of management relates directly to the availability and effective use of information. Co-ordination of relevant information systems and their use could increase the economic growth rate and promote the well being of all our people. On the other hand there is a great danger that should information systems grow in a disorganized and fragmented fashion or be developed extra-territorially, the potential benefits to Canada would be lost.

The study did not produce a formula which related benefits to costs. It has been suggested, however, that the benefits could include prevention of unnecessary duplication, improved planning capability, improved decision making capability, enhanced creativity, better opportunities for innovation, production improvement and diversification.

The importance of user involvement has been stressed. Users must both contribute and receive data and it is suggested that as they will be the greatest direct beneficiaries, in most instances costs should be recovered from them.

Organization of the Study Sub-group

Ideally each activity which could beneift from a data bank would fall into a recognizable category. It would then be placed in a family each member of which, in the main, would have common characteristics. A study then, of the requirements in one category would establish a prototype which could be adapted for use in all related categories.

This ideal could not be achieved for this study as the members of the group recruited to undertake it were all skilled and knowledgable in specific fields. As a result early in the discussions surrounding this study, the following six sectors were chosen for examination.

a) Legal

b) Industrial

c) Urban

d) Medical

e) Resource

f) Consumer

The study group was formed into sub-groups each of which was assigned a sector. Each sub-group worked within the stated objectives, but as they applied to their individual sector.

Common Conclusions of the Sub-group

Major problems and factors influencing the process of developing data banks and the institutional arrangements believed necessary to facilitate the formation and operation of these networks are the focal points of these special studies. More than anything else, these studies show us that there is no general manner in which to optimize the development of data banks, that institutional arrangements will not be mutually exclusive but that they will vary according to the nature of the sector and according to the stage of development attained in that sector.

Among the factors which will affect the development of data banks are the following:

1) awareness of informational needs

2) technological factors

3) institutional factors

4) political factors

5) legal factors

6) economic factors

7) financing data bank services

8) international considerations

From the consensus reached in these studies, it must be said that any attempt to create data bank networks is a multiphased effort which may involve differing institutional arrangements depending upon the processes as they occur in each sector. Two general processes, each involving different phases can be seen, those of planning-implementation and operation. Of certainty, the institutional arrangement most acceptable during the crucial planning-implementaiotion process must be able to integrate diverse but related interests, not the least of which is the user himself, with the purpose of emerging with a uniform policy on data banks. It is important to differentiate these processes into a phased approach. This has the effect of minimizing unnecessary features and errors since the approach implies justification at each step.

Six phases can be readily envisioned:

1) The Exploratory Phase

2) The Conceptual Phase

3) The Design Phase

4) The Implementation Phase

5) The Operational Phase

6) The Audit Phase

Generally, these phases correspond to the processes of planing, implementation and operation.

More than any other criteria, user requirements for and acceptance of the systems must be secured. Emphasis must be given to the ability of users to contribute information to the system or the end result will be a system which is predominately one-way and subject to an excessive degree of centralized control.

Extracts From Sub-group Submissions

a) Legal Sector:

The main factors likely to affect the development of legal data banks are economic and legal in nature. Technological factors only arise in relation to economic ones.

The only technological factor which does place restrictions on the development of a legal information system at present is the current stage of development of the appropriate computer programs.

b) Industrial Sector:

Very often, the designer, aware of technical and perhaps economic feasibilities, ignores the user's most basic problem, the defining of his information needs. Government must not impose information systems on the user before he has become aware of and attempted to define his needs. One necessary condition is user awareness.

An essential first step is a marketing oriented familiarization campaign to aid industry in gaining an awareness of information as a resource and of its economic impact on both the firm's profits and on the Gross National Product.

c) Urban Sector

Wide variation is evident in urban functions, in cities of different sizes and in different parts of the country and in their dependence on available sources of information. Mutual aid could clearly improve the use of pertinent urban information for all concerned.

The absence of a unified local, regional or country-wide responsibility for the organization of information services is a major cause of the difficulties encountered by users of urban information in Canada. Governmental as well as non-governmental bodies handle various elements of urban information, often in isolation from one another and without explicit criteria of the service they need to offer.

The need for comparative information is hampered by the absence of standards and norms; data gathered at great effort and expense in one office cannot be used by other administrative units because of the differences of definitions and standards. Capability in one language only limits possibilities for comparisons of ideas facts and data.

Small centres could overcome many of their difficulties by pooling their information resources in regional co-operatives and sharing their costs. Improved information services require more qualified staff and the use of advanced technology. Regional co-operatives could arrange interchange of information among themselves and with other levels of government.

d) Medical Sector:

One of the most wasteful aspects of patient care, in hospital or outisde, is the taking and retaking of patient histories. The creation of a data bank of patient records covering all treatments would probably be the most meaningful contribution in the public interest.

The Report recommends:

1) That a full-scale survey of the needs of the health community for data banks be commissioned and carried out.

2) That steps be taken to educate the potential users on the advantages of data banks. This education should start early and preferably at under-graduate level.

3) That ways be explored to support those data banks which are necessary in the public interest.

e) Resources Sector:

Technological problems, while presenting major difficulties, are not considered to be seriously limiting. The major limitations will be in regard to the availability of skilled manpower and sufficient financial resources.

The Report recommends that:

1) A national policy should be formulated with regard to development and operation of data banks in the national and public interest. The complex nature of the data banks themselves, the need for inter-communications among different banks, the problems arising from the fact that organizational barriers will be crossed and the need for protection of vital or sensitive information make this an urgent requirement.

2) A National Advisory Committee should be established to assist in the formulation of such policy, and to assess, and make recommendations on national priorities and the need for specific data banks.

3) A Central Systems Group of analysts with knowledge and experience in information retrieval systems should be established in Government, to provide technical advice and assistance to, and to act as a secretariat for the National Advisory Committee and to actively participate in the design and implementation of specific data banks of high priority.

4) Due to the complexity of assessing data requirements and the organization best suited to each data bank, it is recommended that standing committees with inter-departmental membership be set up to determine these requirements and present initial plans to the National Advisory Committee.

5) Planning and implementing data banks will involve government departments at all levels; federal, provincial, regional and municipal. To facilitate appropriate separate or co-operative action, it is recommended that studies of exising legislative requirements be made for all departments involved.

6) If data banks are employed efficiently there will be a concomitant reduction in the storage of redundant data. This will result in unique value being placed on data bases. In that organizations other than governments may be entrusted with the establishment and operation of such data banks in the public interest, it is strongly recommended that legislative action be taken to ensure that the ownership of data bases of particular value to the public remain with government.

and not form part of any assets that may be sold or otherwise acquired by another party. Essentially, a trusteeship is advocated.

7) Data banks will become progressively cheaper as technology advances encouraging the storage and retrieval of original, observational data. This is not without its dangers for such data may never face the scrutiny of expert referees and invalid data, processed by inappropriate and possibly undefined statistical programs can spread false information harmfully. It is recommended that considerations be given to operational regulations to minimize such risks.

8) It is a common concern that privacy of personal data and protection of proprietory material may be compromised in data banks and that system malfunction can assign incorrect identity, to the detriment of the individual. It is recommended that codes of ethical use of such data bases be prepared and that the necessary legislation to establish and protect the rights of the individual be enacted.

9) Much of the anticipated value and efficiency of data banks will be sacrificed if minimum standards of coding, format and content are not officially encouraged. It is recommended that appropriate action be taken to develop and support such standards and to establish a Canadian registry, and eventually a data bank, carrying such descriptive data as necessary to permit access and use of all data banks established in the public interest.

10) Centres of expertise in information retrieval systems should be developed at two or three Canadian universities to encourage closer co-operation between universities and industry, and to provide facilities for training in an area where demand far exceeds supply.

11) Government should contract out the development of some of the required data banks to these univerisity centres.

12) Highest priority should generally be given to those data banks providing information for decision-making and planning purposes.

f) Consumer Sector:

The immediate need is for a clearing-house for public information systems now being developed or planned in both the private and public sectors.

Both as a final good (TV programs, radio entertainment, education courses taken for pleasure) and as an intermediate good which affects the speed and effectiveness of the individual and family decision-making (consumer information, job opportunities, training courses), information plays a central role in determining the welfare of Canadians.

Recommendations:

In addition to the publication of this report, the Urban sub-group will publish its report as will the Consumer sector. It is recommended that these reports be referred to the CCTF to be used as source documents respecting the various problems identified.

The Legal, Industrial, Medical and Resource sector reports should also be referred to the CCTF for detailed study.

It is finally proposed that in any future studies full recognition be given to the bilingual nature of Canada.

SECTION II

INTRODUCTION

Importance of the Subject

In considering the relevance of large remote access data banks it must be kept in mind that the need for information arises every time there is a task to be performed or a problem to be solved. To satisfy such needs information may have to be obtained from an information system, from person to person contacts or both. The most efficient method would be referral to an information system that could provide immediate and complete data relevant to the task or problem. Given the present state of technology, this could be in the form of a computerized data bank which stores information and includes media for input, manipulation and retrieval in a usable form.

Information storage and retrieval are not new terms to mankind; indeed, the concept has existed since prehistorical times. However, the concept has grown to include "gathering, evaluating, processing, packaging and distributing of information to serve customer needs; acquisition, editing and editorial, indexing, abstracting, programming and reproduction; all forms of dissemination including the mails, telephone, telegraph, radio, television and computer networks". (1)

This generation of Canadians is living in an age of great technological progress. This progress produces vast amounts of information which in turn becomes the raw material for future progress. The flow of this information creates a significant challenge in terms of both its quality and quantity. The challenge of the information system therefore is to rapidly convey and make accessible relevant information from the source to its user.

Since the end of World War II, Japan has made miraculous strides in its economic recovery. The following extract from the Computer White Paper published in 1969 by the Japan Computer Usage Development Institute shows the importance that nation attaches to the field of Information:

> "In the age of the industrial revolution the first countries to industrialize took the position of leadership as advanced nations. Likewise, in the present age of the information revolution the first countries to computerize will become the leaders in the information-oriented world of the future.

(1) INFO EXPO 70 Program Washington, D.C. 1970, P. 43

> The spread and evolution of computer usage over the next ten or twenty years will, beyond a doubt, work revolutionary changes in man's world, changes that will greatly effect every field of his activity. It is thus the responsibility not only of governments but also of those in finance, labour, mass communications, and education, not to mention many other fields, to seriously consider the problems involved from a national point of view."

In Canada a great deal has already been written and said about the benefits to be derived from data banks and information systems. Special Study No. 8 for the Science Council of Canada, for example, has expounded on the value of an integrated system for Scientific and Technical Information in Canada. Much of what was written in that report is of direct application to data banks in general.

It is important for all Canadians to consider the communications and information services available to them. Since information is a vital resource, it is as important to productivity as land, labour, capital and management. In fact, one can state that any co-ordinated acceleration of relevant information transfer should increase the economic growth rate of the nation and most likely the well-being of its people.

It is now feasible to envisage information systems readily accessible to all segments of society including business, government and labour, containing vastly expanded and improved information about consumer goods, education, job opportunities, urban affairs, the services of business and government, and the major disciplines at large.

The presence and accessibility of improved information will allow social institutions to more effectively monitor their environment and increase the speed of adaptation to changing demand patterns. It has been estimated that in 10 years, 75% of the products manufactured in the United States will be new relative to those of today. Unless the businessman applies new techniques, processes and materials, he may be forced out of business by these changes. Skilled manpower is necessary in these new fields; potential workers unemployed because of job obsolescence must be retrained so that they may find a meaningful

social and economic role in Canada. Unemployment, a socially and individually degrading state, is often the result of poor resource allocation, partially dependent upon the speedy transfer of information. Rapid movement of individuals between jobs will go a long way towards eliminating social-psychological resentment held by the unemployed towards our "affluent society". Service to the individual cannot be placed low in the order of priorities. The existence of data banks to store information related to employment opportunities by type, location, salary, educational opportunities, marketing information, housing and legal status would benefit the individual immensely.

As an example in the field of education the University of Illinois initiated its PLATO* program in 1959. An objective assessment of the evolution and potential profits of this program is contained in the serial 'Science', Volume 167, entitled "Advances in Computer-based Education".**

The stated objectives of the PLATO program are:

1) "Investigation of the potential role of the computer in the instructional process. The major objective of this phase has been to examine the question, 'What is educationally possible?'

2) Design of an economical and educationally viable system incorporating the most valuable approaches to teaching and learning developed in the above investigation."

* PLATO is an acronym for "Programmed Logic for Automatic Teaching Operations".

** Although many universities are doing work on Computer Assisted Learning, such work on a national scale is being carried out by the National Research Council under the direction of Mr. W.C. Brown. The program launched in 1967 and to be tested over a period of about 10 years, was set up to provide co-operating groups of educators anywhere in Canada the opportunity to use a dedicated central computer at NRC free of charge, accessed through remote terminals and telephone communication channels. Educators can then begin preparing and evaluating courses written in natural language and can exchange these through the central computer with other contributors, for their evaluation and use. One of the prime objectives is the standardization of language.

By March 1970, this program had logged over 100,000 student-contact hours (much of it for academic credits), in at least 20 fields of study at all levels of education. Achievements include the realization of many new teaching strategies, valuable experiences in the different institutional environments and the assessment of attitudes of students, teachers and educational authors.

The article provides a detailed analysis of the system economics and concludes that a cost of 35¢ per student-contact hour is feasible during the early 1970's. One PLATO System operating 10 hours per day could provide 10 million contact hours annually which is equivalent to the total annual hours of instruction at a 4 year undergraduate institution with 24,000 students. It is estimated that the system replaces approximately 25 per cent of current teaching practices.

The article lists some of the potential benefits of computer aided instruction:

(1) Gradual abolishment of lock-step schedules and narrowly specified curricula in formal education. Students could proceed at a pace determined by their own capacity and motivation.

(2) Provision of remedial instruction or tutorial assistance during regularly scheduled courses for students with insufficient preparation.

(3) Reduction in the number of large lecture classes at the college level in favour of small instructional groupings and seminars.

(4) Special instruction at home for physically handicapped students.

(5) Development of arithmetical or other skills at the elementary level, in the absence of the often competitive environment of the classroom.

(6) Effective job training or retraining for any employee group especially affected by expanding technology.

(7) Continuing education for professional personnel, permitting the updating of knowledge and skills in their own offices and on their own schedules.

In a current study on "Better Use of Information in Canadian Urban Affairs", conducted under the auspices of the Canadian Council on Urban and Regional Research, it was found that:

> "The absence of a unified local, regional or country-wide responsibility for the organization of information services is a major cause of the difficulties encountered by users of urban information in Canada. Governmental as well as non-governmental bodies handle various elements of urban information, often in isolation from one another, and without explicit criteria for the service they need or offer.
>
> Valuable time is wasted in having to scan an excessively wide and heterogeneous range of information sources, particularly as to certain municipal functions. The information delivered to the users is rarely selected for their purposes, so great amounts of information received are of little value to the user.
>
> The great variety of information required for administrators indicates the need for a highly condensed and organized kind of presentation that is rarely available.

If the potential social benefits of the new medium are not fully developed, as for a variety of reasons they may not be, then widespread public access to improved information is unlikely to be realized. There is a great danger that should these systems grow in a disorganized and fragmented fashion the potential benefits to Canada would be threatened. Instead of improved information handling the presence and incidence of relatively poor decision-making would prevail. As a result, the public interest would be sacrificed and the potentialities unrealized. The administrative efficiency of Canadian institutions would be jeopardized and the possibility of a new Canadian Information industry, potentially one of the largest, might never materialize.

At present no definitive formulae can be associated with the monetary benefits from information systems and services. However, benefits have been shown to include prevention of duplication, improved planning capability, improved decision- making

capability, enhanced creativity, innovation, and production improvement and diversification. It is extremely difficult, however, for members of industry to appreciate the potential value of more integrated information systems since they are rarely aware of their current information expense nor of the real value of appropriate information used wisely.

The importance of information technology is seen more clearly in the areas of social impact and regulation. Nowhere are the winds of change blowing more briskly than in the area of regulation. Regulated industries are moving into unregulated areas and unregulated industries are attempting to move into regulated areas. On the social side it is not yet clear whether the merger of computers and communications will link us all together in a "global village", (as suggested by McLuhan and others), or will splinter society into individuals supported by individualized information systems.

It is clear that technology only tells us what is possible. The technology of today exceeds by far our ability to make efficient use of it. It is becoming more evident daily that without co-ordination and leadership chaos could easily result. This could nullify the many benefits this new technology could bestow if intelligently applied.

Economist Leo Cherene stated the problem well when he wrote:

> "The computer is incredibly fast, accurate and stupid.
> Man is unbelievably slow, inaccurate and brilliant.
> The marriage of the two is a force beyond calculation."

The importance of this study lies in the contribution it may make in the implementation of a cohesive policy to optimize and speed the devlopment of data banks and information systems. As mentioned above without such a policy in Canada, the potential benefits to be derived form this resource (information industry) will not be achieved.

Purpose of the Study

As stated above in the general comments on the importance of data bank networks, it is abundantly clear that the scope for the development of data banks is extremely wide and diverse. Because of the key role information will play in Canada and because of the potential national income to be realized by the orderly development of this "new" industry, the purpose of this study is to discover and grasp the future potential information needs of society and to develop a policy which will maximize the benefits to all. There are almost infinite possibilities for the design and institutional arrangements of data banks. It is believed that there is no one satisfactory approach to the establishment of institutional arrangements for such a diversity of data banks. The nature and function of the data banks, determined by the user, will directly influence the ultimate institutional arrangement which evolves.

This study was designed to determine some of the many possible institutional arrangements. With this purpose in mind, group meetings referred to in the next section were held. From these discussions a proposal and/or format for the analysis of alternative institutional arrangements was generated. This approach to the problem is discussed at some length in the section entitled "Analysis of Institutional Arrangements".

The purpose of the study goes further; it incorporates some of the long-range goals defined by public agencies, particularly, the Economic Council of Canada which has set out a number of economic objectives and concomitant social goals towards which the Canadian Government should move. The Annual Reviews of the Council chart a pathway towards accomplishing these goals. A number of sub-goals or strategies have also emerged and it is these which have social implications. As pointed out by most of the sub-groups, there is an increasing awareness of the economic value of information and its potential role in contributing to the realization of these goals. Inflationary trends have often been attributed to a slow response from the economy due to the poor transfer of economic information.

In recent months the Government has been reviewing the problems of foreign ownership and Canadian sovereignty. An international boundary does not stop the flow of data regardless of how it is transmitted. Consideration must be given to developing Canadian systems for the storage and retrieval of data to ensure

that our citizens do not have to turn to extra-territorial organizations for the services they require. This and many other aspects of information services require priority.

Only by relating this study to those of public institutions at large can we develop a cohesive policy approach to minimize inefficiencies caused by duplication and an overall lack of communication. For example, the economic and social value of information to Canadians must be related not only to themselves, but also to the socio-economic goals defined by Government organizations. The ordering of these priorities will largely determine those policy options open to the Government.

Our purpose is also to aid in stimulating public discussion of these most important priorities as well as their relation to the concepts and implications of information networks in Canada. Information networks can and will play an integral role in the achievement of objectives so set.

Organization of the Study

This study was carried out by a project team whose members were drawn from universities, industry, trade associations, government agencies, the Consumers Association of Canada and the Canadian Council on Urban and Regional Research. All members of the project team were recruited for their knowledge and experience in information systems generally as well as their individual professional expertise. A list of the members of the project team is shown in Exhibit II of this report.

Because of the professional expertise of the members of the team six sub-groups were organized: Consumer, Industrial, Legal, Medical, Resources, and Urban Affairs. The study group considered that in each of these sectors data bank systems may be expected to develop in the near future.

Meetings were held to develop the Terms of Reference, included as Exhibit I, and to clarify the approaches to be taken by each sub-group. All sub-groups were represented and played a role in formulating the terms of reference of this study. However, it became increasingly evident that the nature of the information defined by the user will, to a large extent, determine the institutional arrangement utilized in each instance. For this reason, special meetings were held with the chairman of each sub-group to discuss a format for analysing optimal institutional arrangements. The approach adopted for this report is developed below in the section entitled "Analysis of Institutional Arrangements".

It should be noted that the report submitted by the Consumers Association of Canada is part of an on-going study to be utilized also for purposes other than this study. As such, their report does not strictly follow the Terms of Reference set out by our group. The following quotation explains this:

> "This document is designed to serve serveral purposes. The entire document, and a covering policy statement, constitutes a submission to the Government of Canada through the Honourable Mr. Eric Kierans, Minister of Communications. The submission deals with the subjects of communications and public information. Part I of the document is also designed for general distribution to encourge public debate and participation in the formulation of communications policy. Part II of the document contains elaboration of the idea of a community information network and will be used as a basis for discussions with other interested organizations and government agencies. It will also be used in connection with the Telecommission studies of the Department of Communications, and in particular Study 5(f) on the development of large scale data banks in the public interest.
>
> Copies of this document are available from the Consumers' Association of Canada, 100 Gloucester Street, Ottawa 4, Ontario.
>
> . . . . "

The report submitted by the Canadian Council on Urban and Regional Research is also an intermim statement of an on-going study concerned with the informational problems faced in the realm of urban governments. It is entitled, "Better Use of Information in Canadian Urban Affairs". dated 31 July 1970.

To quote the Urban Information Exchange Service Project:

> "The Council has for some time been engaged in a project to improve the accessibility and transfer of urban information in this country. We have now come to the closing phase of our project and our Expert Team will shortly be writing their final report.
>
> At this point, they invite the objective assessment of experienced and competent people in this field;

they ask your views on the urban information situation uncovered and particularly on their proposals for solutions.

The enclosed Interim Statement was prepared as a basis for your comments. It is neither complete nor comprehensive; rather it is meant to outline as briefly as possible the experts' thoughts on the problems discovered and on ways to solve them. Detailed findings and explanations have been reserved for the final report, of which this Statement can be considered as an outline."

The Industrial Sector study was carried out by members drawn from industry and two trade associations under the leadership of Mr. J.P.I. Tyas of the Federal Department of Industry, Trade and Commerce. The names and organizational relationships of the participants in this sub-group are shown in Exhibit II. A questionnaire was sent to 41 industrial associations asking for views and opinions on the type of information services that would best serve industry. The questionnaire and distribution list is shown in Exhibit III.

The Medical Sector study was carried out solely by Dr. A. Sherrington of the Department of National Health and Welfare. Dr. Sherrington collected views and opinions by personal interviews of leaders in the field of medical information systems.

The Legal Sector study was carried out by members drawn from three universities under the direction of Mr. J.W. Ryan of the Department of Justice. Members of this committee are shown in Exhibit II. A questionnaire, shown in Exhibit IV, was mailed by the Department of Justice, to all lawyers in Canada except those in the Province of Quebec. Lawyers in the Province of Quebec were excluded from this survey as the results requried were available from another survey recently concluded for that Province. The Province of Quebec questionnaire is also included in Exhibit IV.

The Resources Sector study was carried out by members drawn from industry and the government under the leadership of Mr. W.C. Brown of the National Research Council. The study was conducted by a combination of:

- questionnaire and distribution list (shown in Exhibit V)

- correspondence

- telephone discussions

- visits to a number of persons

- attendance at conferences on data banks

- review of relevant briefs previously submitted for other federal studies.

The Resources Sector sub-group followed closely the Terms of Reference established by the project team. Since this report was a comprehensive examination of the problems in question, their study provides a very useful framework for the final report. This framework has been adapted and altered as a result of the contributions of other sub-groups and, as such, provides much of the final report.

Exhibit VI lists the "table of contents" of the separate reports of the individual sub-groups.

Because all the sub-group reports included common areas, we have been able to integrate them into the present framework. This report represents a consensus of opinions and statements found in all sub-group studies. We are deeply indebted to all those who took part and who contributed their opinions and suggestions, while giving so freely of their time.

Organization of the Final Report

Section I of this report is a summary which brings together the conclusions common to all sub-group reports. Section II, the Introduciton, has been sub-divided into four sections: Importance of the Subject, Purpose of the Study, Organization of the Study, and Organization of the Final Report. In general, the last two sub-divisions describe how the work was organized, implemented and the report written. Section III, Summary of Special System Designs, is a synopsis of each sub-group's contribution to this Study. These synopses are simply short presentations and summaries of the main trend of thought contained in each of the six reports submitted to the Telecommission.

In Section IV we have brought together all those factors which were considered common and which would influence the development of data banks. The factors identified were: awareness of informational needs, technological, institutional, political, legal,

economic, financial and international. Therefore this Section is an integration of the work carried out by the sub-groups.

As mentioned above, Section V, Analysis of Institutional Arrangements, presented special problems which had to be reconciled before this Report could be written. The sheer diversity of possible data bases necessitates a matrix approach to the presentation of alternative institutional arrangements. This approach is in part, the result of a series of special meetings with the sub-group chairmen and of an integration of the views expressed by their contributions. For purposes of organization, three phases were identified: planning, implementation and operation. The institutional arrangement utilized will not necessarily be the same throughout the three phases leading to an operational data bank.

SECTION III

Summary of Special System Designs

This section presents a synopsis of the major findings set out by each of the six sub-groups. One should keep in mind the summary nature of this section and refer to it while reading later sections. The purpose of Section III is simply to present the main arguments brought out by the sub-groups so that one may relate these reports to the final report.

A) Legal Sector Report:

The objectives of this study were to investigate the need for a legal data bank, to discuss its requirements and suggest how these requirements might most economically and efficiently be met.

In the appendices to the study are set out copies of two questionnaires, one sent to all members of the legal profession in the Common Law provinces and the other to all members of the legal profession in the province of Quebec, together with the replies to these questionnaires. (In the case of the Common Law questionnaire, only a sampling of approximately 1200 replies was possible in the time available). These questionnaires are included in this report as Exhibit IV.

The lawyer is more dependent on recorded information than any other professional man. This is best illustrated by the following paragraph from a talk given by Mr. W.B. Eldridge at Queen's University Conference on "Computers and the Law" in May 1968.

> "In my view, literature has a role in law quite different from the role of literature in any other discipline. Many disciplines refer to "primary" and "secondary" sources. In the natural sciences, primary sources might be defined as the reports by experimenters of observed physical phenomena under controlled conditions in accordance with scientific literature that presents analysis, evaluation, and rationalization of the results of experimentation could be defined as secondary sources. Law also has primary and secondary literature. Secondary literature is functionally much like that of sciences. It is composed of the analysis evaluation and rationalization of the primary literature.

At the level of primary literature, however, a critical difference exists. Primary literature, is not descriptive of the phenomena of law, it is the phenomena."

The long life of legal information and the phenomenal increase in legal relations between people - an increase which over the last few years, has been paralleled by the growing socialization of human activities has brought about an increase in the volume of legal data. A brief look at the long list of material available for legal research reveals the difficulty of the task. The primary sources of the law are:

1 - the cases before an increasing number of courts of justice (The Supreme Court of Canada, the Exchequer Court of Canada, Courts of Apepeal, Superior Courts, Provincial, District and County Courts, Criminal Courts and others).

2 - the Codes, which try to regroup under one heading, material pertaining to one particular subject, (The Civil Code, Codes of Procedure for the province of Quebec, the Criminal Code).

3 - the statutes.

4 - the statutory orders and regulations or by-laws of the three levels of government.

5 - the ruling of special tribunals such as arbitration boards, administrative boards, etc.

The secondary sources of law are treatises, restatements, periodicals, commentaries and encyclopedias.

Since none of the current research tools cover the entire legal field, a lawyer frequently needs days or even weeks to make sure he has traced all relevant documents. Needless to say, the cost of such research is very great. Sometimes because of inadequate organization the same legal problem is researched several times by different lawyers.

The judge must also be certain that the arguments presented to him in court contain all of the relevant authorities before he can decide upon the outcome of the case. Considerable time may be required for this.

In addition to these circumstances which affect the entire profession, examination reveals a fundamental inequality between

practitioners. Large firms clearly have advantages with regard to legal research. Often they have extensive library facilities, clerks or professional researchers, and well prepared case files as well as a comprehensive filing system built up over the years. With such resources these lawyers, who are often highly specialized, are in a distinctly advantageous position to handle the most complex problems which their clients may submit to them. The type of justice obtained may depend upon what a client can afford to spend on legal services.

The main factors likely to affect the development of legal data banks are economic and legal in nature. Technological factors only arise in relation to economic ones.

The main legal problem is likely to arise in the area of copyright. The bulk of reported cases are published by private companies who hold the copyright for that material. If no arrangement can be made with regard to this copyright, recourse would have to be made to the original typewritten manuscript of the judgment.

The economic factors relate to such things as the cost of large scale data storage, the cost of data input, the cost of long distance communications and the cost of terminal equipment. These could be reduced by improvements in the technological area.

The only technological factor which does place restrictions on the development of a legal information system at present is the stage of development of the appropriate computer programs. The shortcoming is not the computer's but lies in the present inability to express in a logical fashion to the computer, the process it is to follow in retrieving information.

The report states that unlike some potential industrial systems a legal information system can not readily be created and administered by its users. Canadian legal practitioners are scattered through a very large number of partnership firms or individual practices across the whole country. There are about 17,000 practising lawyers in Canada. In addition there are 7,000 students and professors in law schools. The very largest law firms in Canada have about 100 members but there are very few of these large firms. The likelihood of persuading this scattered group to make the necessary decision for the planning, financing and implementing of a major system is small.

Although the views of this large body of lawyers and other potential users have been hard to assess, some steps must be taken to involve them in the planning of a system. This might be done through law societies and bar associations, etc.

It might also be possible to involve the National Council on the Administration of Justice in Canada in the planning of the system. This body includes the Provincial Deputy Attorneys-General or their representatives thereby involving the provincial governments in the process.

Ideally the conceptual planning stage should involve the Federal Government, Provincial Governments, members of the legal profession and other special interest groups, such as universities.

Three steps are involved in the implementation phase. These are:

1 - the establishment of the organization which is to handle the operation of the system;

2 - the creation of a data base consisting of:

a) statutory type materials which might be converted at a central location or copies obtained from provincial governments or a combination of these two,

b) Case Law, the input of which should be co-ordinated through a central organization.

The implementation process should be regulated and supervised by the organization which is eventually to operate the system. However, special interest groups, such as universities, might well be involved in the implementation stage either in the area of systems development or of data conversion.

The responsibility for the operation of the retrieval system can be assigned to any one of a large number of types of control groups. For example, it could be assigned to a crown corporation, a department or agency of government, an intergovernmental body, some form of consortium, a special interest group (e.g. universities) or private enterprise generally. Some of the advantages and disadvantages are set out as follows:

(a) <u>Crown Corporations:</u>

A crown corporation, whether Federal or Provincial, has certain tax advantages, no dividend allocations, no debentures, no trust deed arrangements. It does report to a parliamentary body, face the committees and accept government direction.

(b) Government Department:

It is difficult to see how a government department could be employed to operate a national information retrieval system since a department is not really organized for this kind of function. Government Departments are more closely associated with government policy than are either the Crown Corporation or the Government Agency.

(c) Government Agency:

A government agency can be given powers to act on behalf of the government in a certain specified field. This has the advantage over a government department as its sole function can be to operate within a specific field e.g., to operate a legal information storage and retrieval service. It has greater freedom than the crown corporation as the legislation creating it may give power to the Minister to extend its shpere of influence by regulation rather than resorting to further legislation as would be required in the case of a crown Corporation.

(d) Intergovernmental Body:

An intergovernmental body would have the merit of involving both the Federal and the Provincial Governments in the operation. This could lead to co-ordination in other types of legal information systems e.g. property information systems.

(e) Consortium or Syndicates:

A consortium or syndicate of Governments, Law Societies, Universities, etc., might offer a solution to the problem of insuring that the system was developed and used to provide the maximum benefit to the general public and the legal profession.

(f) Special Interest Groups:

Special interest groups, such as universities, seem better involved in offering service in the implementation and development phase. They are not designed and set up to administer an operational system. Their facilities are intended for research and training purposes.

(g) Private Organization:

The system could be operated by a private organization although some difficulty might be experienced in raising the capital required for the large scale data conversion required.

Government regulation of the industry, as well as financial support in at least the initial stages of the development of public service data banks may be necessary.

B) Industrial Sector Report:

The Industrial sector sub-group has taken an "information" approach to the decision-making and problem-solving processes. A data bank is essentially a storage and retrieval system for information. Regardless of the data bank family, e.g., consumers, urban affairs, etc., information contained within the system is used in a problem-solving or decision-making manner. The most significant use of information lies in its potential to aid and enhance these processes. The user of an information system must play the key role for it is he who defines the nature and form of the information contained in the system. Survey efforts by the sub-group demonstrate the present low awareness of a large segment of the business community with respect to the use of relevant information in their day-to-day activities. Economists and students of business administration are aware of the relationship of information to improved decision-making and problem-solving. But the user, at the same time as he demands performance from his staff, is not fully conversant with the needs of an effective information system to achieve efficient operations.

Policy-makers often have a tendency to accept those views which further develop and reinforce existing ideas but in the field of information processing, interaction between the user and the designer must be considered of primary inportance. It is well to point out that neither party alone is both necessary and sufficient to the successful planning and implementation of an information system. It therefore becomes very important that the designer, who may be in the policy-making area, never separate himself from the users. Only the user can attempt to define the nature and form of the information he believes to be of use. Since form is generally determined through user knowledge of information problems, the user is in a position to influence the feasibility of a data bank by properly defining needs or problems. The role of the designer should be to provide the hardware and software of the system in a way which will maximize the use of the contained information.

Because of his awareness of the technical and perhaps economic feasibilities, the designer of a system may often ignore the users most basic problem which is defining his information needs. The Industrial Sector Report indicates that this is indeed the major problem facing industry today. Small firms and

firms serving less developed markets lack knowledge of information gathering and retrieval. Government, in view of the facts presented, must not impose information systems on the user before he has become aware of his needs and has attempted to define them. In the implementation of an information system the necessary condition is user awareness.

When the goal of an information network is decided upon, an analysis of the present state must be carried out. At this point in time the first step should not be to commence systems design but rather to familiarize the user with methods of gathering and differentiating the information he considers useful. Designer and user must then work together in the design of a system which will maximize usage of the information contained in it. Pilot projects can be initiated to refine the design of the system in line with the operating criteria established earlier by user and designer. Simultaneously with the design stage private and public sector officials can establish final institutional arrangements and financing for the system. It is the opinion of the Industrial Sector sub-group that a co-ordinating authority, financed by government, should initiate the early familiarization stage. The financing of this step will have to be considered separately from that of the design and implementation of the banks.

Only by following the sort of progression discussed above can the policy-maker avoid the pitfalls of premature commitments of resources to inadequate systems. Not only could the system be chaotic and expensive in the sense that it would contain irrelevant and little used information but also it would be expensive to industry and the individual Canadain taxpayer.

The logical first step is a marketing oriented familiarization campaign to aid industry in gaining an awareness of information as a resource and its economic impact on both the firm's profits and on the Gross National Product. Governments' responsibility at this stage is to work at this most fundamental level. Only then can management become fully conversant and experienced with the uses of information systems.

From the above discussion, it is evident that the major criteria for deciding upon data bank pilot studies lie in the particular families' ability to differentiate the useful from

the useless. Some families are obviously more prepared to establish information networks in certain aspects of their field than is the Industrial Sector.

C) Urban Sector Report:

The Canadian Council on Urban and Regional Research in conjunction with agencies of the Federal and Provincial Governments and Municipal Administrations have made a study of the accessibility and transfer of urban information in Canada.

The Council set up a team of three experts to direct the project. This team was assisted by an Advisory Panel consisting of knowledgeable persons from many urban governments and information services. Under their direction a consulting organization was hired to carry out a survey of urban information users and sources in Canada and abroad.

The survey of user requirements involved interviews in a structured sample of over 120 Canadian units of urban administration; of these 90 were in municipal offices distributed across the five major regions of Canada and using both official languages while the others were in provincial and federal governments, in municipal associations and in universities. The responses of urban information users revealed their habits and difficulties and, particularly in the few cases where possible, showed something of current costs of searching for, interpreting, processing and transferring urban information in Canadian governments. The chief difficulties and defects in present practice are clear enough from this survey to enable performance specifications for a Canadian Urban Information Exchange Service to be set out.

The surveys of sources in Canada and abroad were conducted with expert knowledge of the field including attention to the sources mentioned by urban information users in the other survey. Wide variation is evident in urban functions in cities of different sizes and in different parts of the country in their dependence on available sources. Mutual aid can clearly improve the use of pertinent urban information sources for all concerned.

From these surveys of users and sources and with the help of the Advisory Panel and others a sketch design has been drawn of a Canadian urban information exchange network. It is meant to offer those in every branch of urban affairs the benefits of quicker, more complete and pertinent information on which to base discussions affecting millions of Canadians. It will offer this

benefit in communities of all sizes, in every region of Canada and using both official languages.

On July 31, 1970, the Council released an interim statement on the findings of their study entitled, "Better Use of Information in Canadian Urban Affairs". This statement outlines the experts' thoughts on the problems discovered and on ways to solve them. It invited an objective assessment of the study findings by experienced and competent people in the field. The detailed findings and explanations of the proposed Urban Information Exchange Service, together with the views expressed on the interim statement, will be incorporated into a final report which is scheduled to be published in the spring of 1971.

The project findings expressed in the interim statement are:

(a) The absence of a unified local, regional and country-wide responsibility for the organization of information services is a major cause of the difficulties encountered by users of urban information in Canada. Governmental as well as non-governmental bodies handle various elements of urban information, often in isolation from one another, and without explicit criteria of the service they need or offer.

(b) Valuable time is wasted in having to scan an excessively wide and heterogeneous range of information sources particularly as to certain municipal functions. The information delivered to the users is rarely selected for their pruposes so great amounts of information received are of little value to the user.

(c) The need for comparative information is hampered by the absence of standards and norms; data gathered at great effort and expense in one office cannot be used by other administrative units because of differences in definitions and standards. Capability in one language only limits possibilities for comparisons of ideas, facts and data.

(d) Urban policy and administration in general suffers from a shortage of people qualified in information handling. As a result there can be little or no systematic inquiry into the efficiency of current information processes with and among administrative units and available methods of information handling are not put to effective use.

(e) Those interviewed in surveying information practices had little cost-data. Thus there is very little objective assessment of information handling costs at any level of use. In all probability municipalities are spending too little for the information they need but too much for the quality of what they are getting. A more penetrating study is needed on this question.

(f) Small centres could overcome many of their difficulties by pooling their information resources in regional co-operatives and sharing their costs. Improved information services will still require more qualified staff and the use of advanced technology. These regional co-operatives could arrange interchange of information among themselves and with other levels of governments.

(g) Urban information users and producers across the country need to define their roles more clearly, increase their resources, co-ordinate their efforts in a network of urban information and establish a clearing-house to ensure the operation of the whole system. Responsiveness to the constant evolution of urban affairs and capability of the clearing-house in both French and English are essential prerequisites. The network must take advantage of up-to-date technology and tie in with related Canadian and foreign information systems.

D) Medical Sector Report:

The terms of reference of this study set down "medicine" as a particular area of study. This was widely interpreted to cover the whole health professional field.

The main purpose of the study was to identify national information services in the public interest which could be supplied by large, remote-access data banks. The necessary support was discussed. Some conceptual designs are described and statistics of user numbers, bank size, type of data stored, frequency of use, and finanacial arrangements are given to place these designs in perspective. Advantages and disadvantages to be considered in finding an optimum solution are noted.

The relationship between the data bank and other banks, users, governments and international systems are explored. Particular attention was paid to the role of government.

The limited time available for the study made it necessary to concentrate on the broad outlines of the problem. This was done by:

- telephone discussions
- visits to a number of interested individuals and leaders in the field
- attendance at conferences on computers and data banks
- review of relevant literature

Data banks would result in increased productivity among scarce and expensive health professional manpower, providing needed information to apply new techniques more speedily and more effectively and to make better use of existing facilities. Ideally data on the incidence and prevalence of all diseases, injuries, disabilities, and impairments in Canadians would be available, providing a starting point for identifying health problems and the requirements of the population. Medical planners need to know the availability of health facilites, the number of hospitals of all kinds, the services provided, and the number of beds. Constant updating of such information is mandatory. Indeed it is with regard to planning for medical needs that a data bank may serve in the most useful way. Up-to-date and relevant data may make the difference to a medical programme and determine whether it is economic and viable.

One of the most wasteful aspects of patient care, in hospital or outside, is the taking and retaking of patient histories. The creation of a data bank of patient records covering all treatments would probably be the most meaningful contribution in the public interest.

Data banks also serve a useful purpose in maintaining up-to-date records of research in all medical fields as well as current information on existing drugs, poisons and diseases. This information is invaluable not only to the practitioner but also to the medical school.

The Medical Sector Report discusses technological institutional, political, legal and economic factors. Problems faced in establishing a medical data bank relate to such functions as federal-provincial co-operation, the conservatism of the medical profession, liability for record errors, right of access to files and the need for federal government financial support.

Like the Resources sector Report the medical report follows the conceptual design format that is discussed in Section V of

this final report. Briefly, these steps are:

- exploratory phase
- conceptual phase
- design phase
- implementation phase
- operational phase
- audit phase

The report recommends:

(a) That a full-scale survey of the needs of the health community for data banks be commissioned and carried out.

(b) That steps be taken to educate the potential users on the advantages of data banks. This education should start early and preferably at undergraduate level.

(c) That ways be explored to support those data banks which are necessary in the public interest.

E) Resources Sector Report:

In considering requirements for data banks for various facets of Canada's resources one is faced with an almost inexhaustible list of possible banks which could serve the national and public interest. Major broad areas include:

Agriculture	Mineral resources
Communications	Pollution
Education	Tourism
Energy Resources	Transportation
Fisheries	Water Resources
Forestry	Weather
Land Use	Wildlife
Manpower	
Pests and diseases of plants and animals	

Advances in computer and communications technology permit the creation of central data storage banks allowing access by users from remote locations. This facility has great potential for benefits to the individual and to the nation but, at the same time it raises a number of difficult problems if benefits

are to be maximized and costs minimized. It also gives rise to a number of fears and anxieties on the part of the individual.

In order to solve the difficulties, resolve the conflicts, and protect the individual, the Government must develop a cohesive and comprehensive policy on data banks and set up procedures for optimizing their development and use.

In the time available for preparing the resources report, it was not possible to conduct an extensive survey of requirements nor to elicit comments and suggestions from all those who could have contributed to the study but a broad cross-section of individuals was queried by personal contact, correspondence, and telephone conversation. An Appendix to the resources report includes specific comments made by some individuals who were contacted.

Data banks will have value only in so far as they are used and used effectively. Section III of this sub-group report discribes briefly different uses of data banks with comments on their importance to the national and public interest. These uses include such functions as planning, control, research, archival storage and general public service.

Section IV of the Resources Report considers some of the problems which will arise in the development and implementation of data banks and their attendant information systems. Technological problems, while presenting major difficulties, are not considered to be seriously limiting. The major limitations will be in regard to the availability of skilled manpower and sufficient financial resources. Probably the most critical problems will arise from the fact that present organizational barriers will be crossed; these problems will be resolved only if there is a genuine will to co-operate. These are informal policical factors with a dynamic character.

The importance of use and user-orientation in the development of data banks is stressed throughout the report and Section V of the Resources report considers user involvement from concept to operation. Without this emphasis a great deal of money and effort can be wasted. It must also be emphasized that users' requests for inclusion of data must be kept within bounds of actual use requirements and that any attempt to include everything which <u>might</u> be used must be strongly resisted. Section V also suggests ways and means of developing a comprehensive Government policy on data banks and suggests procedures for assessing priorities and requirements.

A summary of recommendations is given in Section VI, followed by a cautionary note on avoiding "band wagon" fever and indiscriminate use of data in the banks which will be created.

The appendices contain background information and suggested terms of reference for a National Advisory Committee and other Specialist groups recommended.

By permission of the authors substantial amounts of material from Section IV and V of the Resources report have been incorporated into the final overall report. This has been done because of the general applicability of the approach taken to the planning, implementation and operation of data banks.

The report recommends that:

(a) A national policy should be formulated with regard to a development and operation of data banks in the national and public interest. The complex nature of the data banks themselves, the need for intercommunications among different banks, the critical problems of jurisdicational responsibilities, the problems arising from the fact that organizational barriers will be crossed, and the need for protection of vital or sensitive information make this an urgent requirement.

(b) A National Advisory Committee should be established to assist in the formulation of such policy, and to assess, and make recommendations on national priorities and the need for specific data banks.

(c) A Central Systems Group of analysts with knowledge and experience in information retrieval systems should be established in Government to provide technical advice and assistance to, and to act as a secretariat for the National Advisory Committee and to actively participate in the design and implementation of specific data banks of high priority.

(d) Due to the complexity of assessing data requirements and the organization best suited to each data bank it is recommended that standing committees with interdepartmental membership be set up to determine these requirements and present initial plans to the National Advisory Committee.

(e) Planning and implementing data banks will involve government departments at all levels, federal, provincial, regional and municipal. To facilitate appropriate separate or co-operative action, it is recommended that studies of existing legislative requirements be made for all departments involved.

(f) If data banks are employed efficiently there will be a concomitant reduction in the storage of redundant data. This will result in unique value being placed on data bases. In that organizations other than governments may be entrusted with the establishment and operation of such data banks in the public interest it is strongly recommended that legislative action be taken to ensure that the ownership of data bases of particular value to the public remain with government and not form part of any assets that may be sold or otherwise acquired by another party. Essentially a trusteeship is advocated.

(g) Data banks will become progressively cheaper as technology advances encouraging the storage and retrieval of original observational data. This is not without its dangers for such data may never face the scrutiny of expert referees and invalid data processed by inappropriate and possibly undefined statistical programs can spread false information harmfully. It is recommended that consideration be given to operational regulations to minimize such risks.

(h) It is a common concern that privacy of personal data and protection of proprietary material may be compromised in data banks and that system malfunction can assign incorrect identity to the detriment of the individual. It is recommended that codes of ethical use of such data bases be prepared and that the necessary legislation to establish and protect the rights of the individual be enacted.

(i) Much of the anticipated value and efficiency of data banks will be sacrificed if minimum standards of coding, format and content are not officially encouraged. It is recommended that appropriate action be taken to develop and support such standards and to establish a Canadian registry, and eventually a data bank, carrying such descriptive data as necessary to permit access and use of all data banks established in the public interest.

(j) Centres of expertise in information retrieval systems should be developed at two or three Canadian universities to encourage closer co-operation between universities and industry and to provide facilities for training in an area where demand far exceeds supply.

(k) Government should contract out the development of some of the required data banks to these university centres.

(l) Highest priority should generally be given to those data banks providing information for decision-making and planning purposes.

F) Consumer Sector Report:

This study was conducted under the auspices of the Consumers Association of Canada and, as stated, is intended to serve a number of purposes as well as being a submission to the Telecommission. Because of the nature of the Consumer's Association this report is more directly concerned with consumer access to relevant and useful information to the individual. Both as a final good (TV programs, radio entertainment, education courses taken for pleasure), and as an intermediate good which affects the speed and effectiveness of individual and family decision-making (consumer information, job opportunities, training courses), information plays a central role in determining the welfare of Canadians. This theme is found throughout the Consumer Sector Report.

Of utmost importance and stressed by the Consumer's Report, is the role served by information in the achievement of the social and economic goals of society. As this role for information increases and becomes more clear, modern means of telecommunications with storage and retrieval capabilities of computers improve to the point where it is now possible to envisage information systems readily accessible to the public. The CAC stresses the potential importance of these services for the well-being of Canadians and Canadian Society.

To maximize these advantages the Consumer's Report envisages a network of information systems under non-profit sponsorship organized in such a way as to remain sensitive to the needs of the users and particularly to users whose financial resources are limited in relation to needs. The information contained in these networks would be as unbiased as possible. To achieve these ends more readily participation by the public in both design and operation should be encouraged.

The Report examines technological features which can facilitate the achievement of these goals by asking a series of questions which must be presented to the public at large to more readily access the impact of communications technology. The tremendous changes in society which will emerge due to the application of this technology must be understood by Canadians.

The report concludes that:

The possibility of creating in Canada a non-profit community information network (a set of linked data banks containing information for use by the general public) should be explored.

A network to link together a set of data banks containing information for general public use would have the following merits:

(a) It would make possible a very great improvement in the efficiency of resource allocation by its effect on household decision-making.

(b) A non-profit system would help to compensate for the deficiencies of the free market in providing adequate information to consumers.

(c) Unlike all other proposals for the creation of data banks its social and economic benefits are made available directly and would not have to rely upon a process of "trickle down" before they could be realized.

(d) Its indirect benefits in the form of experience and initiative generated among those who work on it are at least as great as those associated with the creation of any other data bank.

(e) The early creation of data banks for public use is likely to speed the widespread installation of a two-way communications capability in Canada with the desirable social effects which this would have.

(f) Its benefits would be widely distributed among different age groups, different income groups, different regions and different cultures.

(g) It would be an essential base and tool for citizens' advisory bureaux.

(h) It would serve as a positive mechanism in the market place to provide a yardstick against which competing domestic and foreign systems could be assessed by the public.

(i) The improvements in public information which it may make possible would reduce the costs of other government programmes.

(j) It would improve the efficiency of the market place by complementing competition policies.

(k) It would provide a vehicle through which essential elements of standardization could be assessed and introduced.

(l) Its creation need not await the resolution of the privacy issue because the data on the system does not consist of records of individuals. Privacy of access for individual users is sufficient.

(m) It could be built upon a number of component parts already existing in the public sector and in the voluntary non-profit field.

The immediate need is for a clearing-house for public information systems now being developed or planned in both the private and public sectors.

The initiative in establishing such a clearing-house which is being undertaken by the Consumers' Association of Canada and with which other organizations are being invited to collaborate should receive co-operation and support from governments.

In terms of conceptual design, the CAC proposes a five phased approach:

Phase I - Clearing-house for Existing and Planned Systems.

Phase II - Feasibility Study - composed of three studies

i) Systems - technical equipment, financial needs.

ii) Data Base e.g. appropriate data base and how to obtain it.

iii) Legal e.g. contractual relationships liability, patents.

Phase III	- Demonstration Project
Phase IV	- Operational Systems in selected locations.
Phase V	- National network of operational systems.

SECTION IV

Factors Affecting the Development and Implementation of Data Banks

Though the term 'data banks' has become a familiar one only in the past few years of this computer age, the realization that they have been with us from time immemorial is of some importance. The collection, indexing and collating of data in conventional files, if properly organized, offer virtually the same facilities and services as computer-operated data banks, although less efficiently. Because the orientation of this study is towards national information services in the public interest, which can be supplied by large remote-access data banks, this report will center on factors influencing only the computer-based data banks, which may be planned to meet national needs economically.

Such data banks differ in principle from manually-operated files only in that they permit:

(1) Higher speed input and output of data.

(2) A facility for the storage and manipulation of origninal data in any combination of variables without requiring the establishment of individual files.

(3) Efficiency unattainable by manual methods when volume of entries is large.

(4) Diminuition of artificial organizational barriers or restraints to data interchange through the use of electronic means for collecting, storing, retrieving, disseminating and printing information.

In the following parts of this section are the factors brought out by the project team that mav influence the development and implementation of data banks. These factors are:

(1) Awareness of informational needs

(2) Technological

(3) Institutional

(4) Political

(5) Legal

(6) Economic

(7) Financial

(8) International considerations

1. Awareness of Information Needs:

One of the most essential factors memtioned by the study groups as influencing the development of data banks was the actual realization by users and suppliers of the decisional importance of information. As cited in the Industrial Sector Report, due either to a lack of awareness of what types of information are actually available or merely to lack of precedent for explicit definition of information requirements, few businessmen approach their decision making activities in terms of the specific information needed to answer particular questions and most businessmen experience considerable difficulty in trying to articulate specific information needs.

As a result of this lack of a clear definition of information needs planning for efficient use of information or effectively using information which has been randomly attained is extremely difficult. Potentially valuable information is worthless if it is not used, either alone or in conjuncion with other information, in the right context and in the most appropriate way. Where information is not considered a resource its use is haphazard. This only adds to the confusion of decision-making; industry wants less information not more. Similarly, in the urban sector, the different levels of administration involved in urban affairs seems hardly aware of the ways in which the growth of information will complicate the major decisions they must take. The rapid growth of larger centres, the novelty of the phenomenon (barely 15% of our population was urban in 1867) often leave those in authority without adequate tools for decision-making in such fields as housing and urban renewal, urban transportation, pollution, etc.

Efficiency depends not only on numbers and qualifications of staff, but also on optimum exercise of their professional competence, including detailed knowledge of the problems to be solved, of available resources and solutions, and of criteria to assess results. It is apparent that a great part of the working time of most administrators is spent trying to organize their information base for decision-making. It is therefore particularly

important to eliminate waste (time spent looking in the wrong place of for non-existent information, time spent by different people in collecting or processing the same information, or time spent on independant and contradictory efforts so that related information is collected and processed in compatible forms).

The study on scientific and technical information, found that most information was obtained through very informal channels. This appears to be true for qualitative and quantitative data including scientific and technical information. While organizations of all types do now have, or are developing, quite advanced systems for obtaining internal information in such areas as finance and control, marketing, production and personnel, there are few formal methods used to obtain external information on a regular basis. With the large quantities of informaion and data that are required and used today, these informal information channels or systems are far from ideal and their effectiveness is often very low. This tends to undermine user confidence in suggestions for new or different information services. In addition, the fear among industrial users of being inundated with even more information leads many businessmen to believe that modern information systems would add to their dilemma as well as raising overhead costs. But it is possible that as firms and commercial organizations see the use being made by their competitors of more advanced information services, they will demand improved services in their sector. There is an increasing desire for more timely information of a better quality, and an awareness of its social and economic importance.

2. Technological Factors:

Data banks will serve the public interest and meet with public acceptance only if they conform to required standards of efficiency, reliability, economy and user orientation. The ultimate aim is the total recall of all useful data in response to a query, without any irrelevant entries, with the minimum expenditure of the user's time, money, and effort, and in the form that he specifies.

This requirement places a great deal of emphasis on systems considerations, especially in those cases where data banks, containing different specialized data bases, will serve the user through remote-access facilities. Factors which justify special attention are the organization, availability and validity of data and continual maintenance and updating of such systems.

While emphasizing the importance of good systems design and the selection of appropriate equipment, the present technology is not considered a major limiting factor in the development of data banks. However, technological aspects do present major problems some of which are covered in this part.

One factor of far-reaching importance to efficiency and economy of operation is standardization of data codes and formats to allow ready exchange of information between data banks, nationally and internationally. The need for action must be endorsed to achieve workable standards for format, coding, system language and continuing Canadian support for groups involved in this effort. Since use of standards is voluntary it will require government and industry collaboration to make them effective. Compatibility was one of the features most commonly noted in all sub-group reports.

In order to achieve co-operation and interchange of information, standardization is required. This matter represents the most urgent and pressing problem within the broader context of achieving compatibility. The urgency arises out of the accelerating trend toward intergovernmental co-operative arrangements in solving public problems the increasing pressures for integrated and comprehensive planning at national, provincial and local levels, and the consequent need for frequent exchanges of information.

The standardization of data elements in common use, and of the codes used to represent these data elements, will promote a better understanding among governments of the information being processed, improve its reliabillty, and enable it to be exchanged among users and suppliers and summarized without expensive and time-consuming translation processes. The over-all usefulness of the information will therefore, be enhanced immeasurably, irrespective of whether the data are processed by electronic, mechanical or manual means.

It is therefore extremely important that in setting up information systems full attention be paid to the manner in which interchange can take place between the different information systems. This is particularly important when machine-based systems are used but is equally important for systems based on

conventional methods.

An area in which standardization is possible, as stated in the Urban Sector report, is in the use of compatible equipment which allows for ready interchange of the materials stored.

Technological factors are of importance to each step involved in data bank operation, acquisition of data, its classification and indexing, storage, retrieval, dissemination and reproduction. Some of these factors identified during this study include:

<u>Acquisition</u>

(1) Importance of acquiring evaluated data to prevent pollution of data bases with data unsuitable for decision functions. Error checking can be expensive.

(2) As storage becomes cheaper pressure will increase for storage of individual original records rather than aggregate statistics to permit correct relationship of data to be maintained for time series.

(3) Timely collection and updating are required to avoid obsolescence of data. Delays up to four years in some data compilations were determined by some of the sub-group reports. Projections and simulation studies of dynamic situations can be sensibly based only on evaluated up-to-date data.

(4) Although remote data banks may be controlled by computers of different type and size an exchange language can permit data interchange. The use of intermedia process computers was mentioned.

(5) As electronic editing and publication trends progress most published data will be made available on magnetic tape for data bank entry. Optical character recognition equipment will supply input from microforms and the printed page.

(6) Use of the data bank can itself generate statistics of value and planning should take this into account.

Classification and Indexing

(1) The system for classification and indexing of the source material in a data base is progressively becoming more mechanized and automatic using digital computers both in the construction and operation.

(2) The efficiency of such systems may make centralized classification and indexing advantageous.

(3) The filing of data can be simplified through such computer operations on its surrogates.

Storage

(1) For some time to come data bases as a collection of documents will exist as printed material or microform reproductions.

(2) Storage should be organized to allow progressive narrowing of the area of search so that information requests may progress successively from title through abstract to text retrieval with higher relevancy and lower cost.

(3) Availability and cost of communications will be an important factor in determining the extent of an area serviced through remote terminals and hence the balance between regional and central storage of data.

Retrieval

(1) Ability to direct the retrieval operation by remote access distinguishes data banks of the future.

(2) The data bank must permit a wide variety of access methods appropriate to user need -- telephone request, teletype, automatic selective dissemination of information by individuals or group profile, retrospective search by batch or interactive terminal inquiry, grouped data for statistical or simulation studies, exchange of data between data bases.

(3) Retrieval of data by natural language inquiry will be a feature of data banks of the future and these inquiries will also be used to modify acquisition and classification operations.

(4) Denial-of-access coding will be required for data affecting national security and personal privacy.

(5) Interchange with established data banks in industry, business and government will require adoption of an exchange language.

Dissemination

(1) Data banks can be a medium for the exchange of data between users.

(2) Data banks may be required to provide outputs in printed, image, audio or coded form.

(3) Accounting facilities are an obvious requirement where charges are made.

(4) Telecommunication channels and suitable interface equipment are available to connect virtually any type of on-line terminal.

(5) Channels having capacities from about 100 words per minute to 60,000 or more words per minute are available, both on private line basis and for random access on a pay-as-you-use basis. Computers can dial distant centres automatically under program control.

(6) When computers are connected by satellite channels consideration must be given to the long propagation time delays in establishing the channel connections.

(7) Less sophisticated systems not employing on-line terminals may be entirely adequate where response times are relatively unimportant.

Reproduction

(1) Output means can influence organization through availability of certain reproduction devices. e.g., Computer-Output-Microfilming (COM) may be required for higher efficiency in major centres. COM operation costs about 15% of impact printing, operates at about 40 times the speed, and the product occupies about 2% of paper printed volume. One hundred pounds of paper output can be stored on 60 standard microfiche.

3. Institutional Factors

Although technological problems will present themselves it is believed that political and personnel difficulties in dealing with governments and institutions will be the greatest barrier to the establishment of data banks. Typical problems foreseen are the following:

(1) Security of data will dictate the degree of co-operation by many users. Sensitivity of apparently simple data is of real concern; even purchasing records and information requests can be assessed to determine plans of an institution. This problem can be corrected by using average statistics rather than raw data.

(2) Extent of access will likewise affect co-operation. If only institutional groups share the bank they can be expected to support it for their own benefit (this in some cases might be considered to be in the public interest) and may indeed undertake its complete support. Once set up however, would the public ever achieve access directly? This

problem may dictate some minimum degree of government involvement in any bank that should have present or future public access.

(3) Source of data can be an influencing factor of some importance. The depositing of publicly-provided resource data in banks can accelerate the growth of resource industries such as oil, gas, mining, forestry, fisheries, etc. and could be expected to bring ready support from industry. Such is not likely to be the case when private industry is expected to provide such inputs however. A free enterprise system requires that free choice remain with the source of such data.

(4) Institutions normally process data which is pertinent to the needs of their organization. Other arrangements would be a compromise and would result in increased costs. They may be reluctant to modify their data banks to participate in the national or public interest unless there is some tangible form of compensation. Simplification of reporting required by government might prove a useful incentive.

(5) The autonomy of institutions is a barrier to data bank networks particularly where they must provide input. The advantage of data banks is that they will enable resources of all kinds to be shared. However, many institutions will have their own banks of information and will need to be persuaded that it is in their interest to share these data. Greater exposure of management to external issues of national concern will assist in lowering such barriers in time.

(6) The uses to which the contents of data banks will be put can be expected to be as varied as the number of users. To maintain efficiency generality of the data stored is desirable with sufficient flexibility of retrieval for meeting the particular needs of the individual user.

(7) The manner of institutional use can influence the data bank design greatly. Continual reference

to large volumes of factual information, particularly if graphics are involved, can be more economically provided by microform libraries locally maintained or updated by service contract. A computer-maintained and manipulated index can be employed where the volume is large. Fully automated data banks are not the only answer to mass storage and retrieval but become preeminent where high speed and remote access make conventional methods uneconomic.

(8) A very generally expressed opinion is that pilot projects are required initially to obtain experience and that the gradual addition of data banks will tend to lessen risk of failure. Initial subsidy by government is an anticipated necessity but the assessment of development charges later to using institutions in favoured as well as operating charges to ensure that data banks are self-sustaining.

(9) The avoidance of redundancy in data banks through either government co-ordination or a co-ordinating agency of special interest groups and effective standards therein is given wide support by respondents.

4. Political Factors:

Although political factors may outweigh others in establishing and operating data banks it is encouraging to note examples in Exhibit VII of data bases that are being supported through the joint, co-ordinated action of many agencies. Resource data files abound within the federal government and provincial governments and a sincere desire exists to reduce duplication and increase their usefulness for planning and decision-making. Making such files common in machine-controlled data bases however requires detailed study and co-ordination. Urgent problems of our environment (such as pollution) have shown the necessity and value of data co-ordination.

Typical of political factors raised during the study are the following:

(1) The user of data banks will directly or indirectly control the input for he can best evaluate the costs and benefits. Errors could inflict injuries upon individuals and organizations. Therefore, governments may have to specify limitations and controls.

(2) Lack of recognition of the need will be a major impediment and user education as to advantages may be needed.

(3) Institutions may be unwilling to place data in a bank that serves a large number of unknown users. This factor might favor small, specialized banks so that economies of scale would be denied; alternatively expensive security measures may limit the operation. In the Industrial Sector considerable fear was expressed that corporations might be forced to supply proprietary information which would be available to competitors. This fear was especially pronounced when industry assumed that government would be controlling the data banks. Quite aside from proprietary information, however, much information and data of a common or general nature arise from industrial activity and it is this information which industry should recognize as being an important input to a data bank and information system. Once this is recognized and accepted industry has the responsibility of supplying quality information.

(4) Variety and conflict of interests will tend to expand the number of data banks to the economic limit. This may not be in the public interest.

(5) In case of proprietary data computer monitoring and reporting of any use may be better than current copyright protection.

(6) The contribution made by a data bank will be a function of its management and objectives rather than size. This places a premium upon accurate methods of defining the required needs. Problems of propriety information could again play a role here.

(7) The co-ordination of physical and socio-economic data is of increasing importance. For instance the relating of physical and socio-economic data in a geographically based system such as the Canadian Land Inventory System appears to be a promising direction in which to proceed.

(8) The value of federal and provincial government co-ordination and standardization is considerable even for data banks to be operated institutionally if efficient data collection and exchange is to be effected.

(9) Data banks' methodology is a marketable commodity at the international level.

(10) International data banks will require standards and co-ordination. Canada should support such efforts actively so that we can influence the decisions made rather than through default, be forced to rely on and conform to decisions made by other governments.

(11) The government should ensure that Canadian resource, industrial, and consumer data bases remain resident in Canada.

5. Legal Factors:

Data banks are not new but computerized data banks raise new problems. Just as new laws were required when the mode of transportation changed from the horse and buggy to the automobile, new laws are required as we change from the manual data bank to the computerized data bank.

Since the economy of modern computers is now making it possible to retain and identify original data the possibility of obtaining more comprehensive statistical analyses will increase. But with this comes the possibility of associating names with the individual data. Limitation of access to such raw data to the originating group by legislation could provide some protection of privacy. Alternatively a requirement to submerge the data in a sample large enough to ensure anonymity but small enough to preserve valuable statistical information may be an adequate answer. For those data banks created in the national

or public interest it is essential to recognize that the data they contain will be used to foster general well-being in Canada. Legislation is necessary in this regard to avoid unauthorized sale of information in these data banks and to prevent it from being transferred by sale or otherwise to other parties in the event that the operating institution fails or changes ownership.

In addition to the overall requirement that data should be guarded from unauthorized use through legislative means, the following points should be considered:

(1) The need to delineate <u>clearly</u> responsibility for the different facets of operation and maintenance of an information system, including:

- collection of data
- validity of data and their up-dating
- validity of the programs used in a computerized system
- hardware operation and physical storage of data

(2) Under what conditions access to the system is available for uses other than those specified when creating the bank.

(3) Procedures for obtaining authorization to acces the data-base or parts of it.

(4) Methods for ensuring security of parts of, or all, data in a bank.

(5) In formulating policy for dealing with the different legal problems which could arise, a prerequisite is a classification scheme for data banks to help in identifying those types which have special requirements. A classification scheme should therefore include a breakdown according to use.

6. Economic Factors:

Economics will more than likely be a limiting factor in the development and growth of data banks. Any economic evaluation should take into consideration the value of information to decision-making and the concepts of economy of scale.

Additional costs over existing or alternative information systems must result in additional benefits to the users and must be based on an evaluation of genuine requirements.

Representative of the economic factors introduced during this study are the following:

(1) The higher the traffic density the lower the overhead costs per unit of handling information. Since communication costs are directly related to volume each data bank requires a specific study of the proper balance between manual and automatic measures.

(2) The larger the data bank the greater the probability that the data store will be more complete.

(3) The costs associated with the acquisition and evaluation of data can be a major economic factor. Procedures for error checking and for obsolete data removal must receive full consideration.

(4) Timely data quickly used for decision-making purposes can be of extreme value; data stored but never used have a "negative" value due to costs of acquisition and storage.

(5) The process of resource allocation, central to the economic theory of pricing systems, depends to a large degree on an efficient communications system to reflect changes in consumer demand. The ability of industry to measure and respond to demand depends upon access to accurate data. The role of information systems of both the industrial and consumer type will facilitate this.

(6) To ensure that data is up-to-date and its availability known, announcement services for volatile data are essential and the scheduling of acquisition for efficient input and use is important.

(7) Machine-independent computer programming will lead to workable compatibility of systems, and hence the efficient interaction of information

systems to the economic betterment of society. An agreed exchange language between data banks is a less desirable alternative.

(8) User experience with on-line interactive terminals to data banks is showing that such terminals can be operated at lower cost than batch inquiry. This is particularly true where the speed of accessing relevant answers is important.

(9) The cost of output services vary widely with type and volume of data. Accounting practices must reflect these differences in order to avoid "cream-skimming".

(10) The high cost of implementing data banks will militate against their development. Economic priorities must therefore be determined. Co-ordination of activity is a prerequisite to establishing a system which avoids the costs associated with such occurrences as duplication of effort and data bases, the lack of interchangability of data, overcentralization, and excessive hardware and software systems.

(11) All efforts must be directed toward attaining a system whose economic return exceeds the cost. One must remember that all benefits are not necessarily measurable.

7. Financing for Data Bank Services:

A business initially expects to charge users within limits established by operating costs and what customers are willing to pay. This provides a measure of elasticity to make a profit. It creates incentive and allows for innovation and adjustments in the way services are priced. In the early years of a new business, especially one involving heavy capital outlay, it is unlikely that revenues will cover all expenses, depreciation, etc. It is normal to draw on reserves during this period.

Where the services are judged to be in the public interest it was suggested that the government may undertake to provide the services to the public knowing that revenues will remain inadequate at least during the initial stages. A service area in which the government could be expected to be the sole provider regardless of profit includes data banks operated in the national interest and containing sensitive, secure, or vital public information. Access might be on a "need to know" basis.

In order to encourage usage of data banks, the view was advanced that information about a service should normally be free but that information from the service itself should be for a fee. Preliminary consultations and estimates, all sales and technical service, literature and training of system personnel might be provided free. Charges could apply to terminal usage, on-line and search effort by the computer system or the staff, and the data retrieved.

Careful consideration should be given to how a service is priced. A valuable service feature could be inhibited by an unimaginative price structure. Some obvious parameters that should be considered for remote access service are, volume, urgency, distance, time of day, and value of service. Value of service is related to the probabilities of reducing errors in decision-making by the user. The worth of a decision based on adequate facts is high. The alternatives mean additional risks to the user. Pricing and customer education are of paramount importance.

8. International Considerations:

The following considerations regarding the use of data bank services between nations form part of this study:

(1) We cannot hope to build enough data banks to house all the useful data available at the international level. Canadian users ought to buy such data outside the country as required. An alternate source for some of this outside data is obviously necessary in times of trouble. This type of data could be housed in a manual data bank in Canada where costs are minimized at the expense of access time.

(2) Canadian data of national interest, such as resources, should be accessible within the country regardless of international economics. Concern here is not that other nations possess our data but that we might jeopardize control of our environment by not storing it ourselves.

(3) Consideration should be given to the support of international organizations which would be financed by various governments and groups, to study, to set standards, and generally promote the development of data banks on a global scale. This would minimize duplication of national effort, provide access to data hitherto unavailable, and promote the exchange of ideas.

Resource, urban and medical data are of considerable interest internationally. It can be anticipated that foreign access will be a factor requiring study and possibly legislative action to ensure protection of national data where necessary while maintaining all possible co-operative links.

While expressing concern here and elsewhere in this report about the misuse and abuse of data, and recognizing the increasing opportunities for this in computerized data banks, it was recognized that in the words of the Glassco Royal Commission "good mangement consists in more than the avoidance of sin". Thus legislation or other measures of control should not be such that unnecessary barriers are placed in the way of legitimate use and that, every help and encouragement be given to the exploitation of these data for the benefit of the nation and the individual.

SECTION V

Institutional Arrangements

The academic and research communities have been extremely active in the development of information systems by supplying system designers for many of the services now operating in Canada and by supporting their development and operation. Because of the potential for continuing technological advancement within the industry it is likely that academic and research interest will be maintained. The universities have an important role to play in establishing national data banks primarily in regard to providing scientific and technical expertise but with more direct involvement in those banks related to education. They will also be large users of established data banks for carrying out specific research projects. These statements are not intended to denigrate the role which has been played by commercial suppliers of computers and data processing systems.

A major influence on the development of an industry (or new industry segment) is the attitude to development within the industry itself. A highly competitive industry, while allowing some duplication of effort, tends to develop not only itself but also its markets much more quickly than a non-competitive, highly regulated industry. By encouraging entrepreneurs in the development of needed banks and by contracting out requirements for development and maintenance a strong industry in marketable software could be developed. But it can be argued that it is not feasible to leave to industry the major role in developing most data banks for this could lead to fragmented development and excessive redundancy while at the same time leaving gaps in the nation's requirements.

Government departments and organizations have played a very active role in the development of computer-based information services to date in addition to their normal one of general industry support and control. They provide not only financial support in the establishment of such services but can help the industry generally by overcoming some of the initial problems involved in developing, operating and marketing a new product or service.

Reports and studies, especially in the area of STI, recommend increased government involvement -- at least from a co-ordinating viewpoint -- in data bank development and information access control. There seems to be general agreement that there must be some kind of control over the integrity of information collected, the kinds of information stored in data banks and the access to that information (especially with regard to information

on individuals).

A factor to be considered if there are few government controls on the computer-based information services is the influence of foreign information systems on the development of the Canadian industry. There are no physical barriers to the transporting of information (via electronic devices or in the mail) across the U.S. -- Canada border. It is possible for U.S. information services to serve markets in Canada and possibly to inhibit the develop ment of similar Canadian services. In fact there are now some SDI and information tape services from the U.S. serving Canadian customers. In addition, the Federal Government will, by definition, have a strong interest in all data banks serving the national interest, and must have direct control over all those banks containing 'sensitive' data with a national security risk, it is essential that it provide catalytic assistance, guidance and leadership.

In Canada, the National Library, National Research Council and the Dominion Bureau of Statistics have all been delegated a measure of statutory general institutional responsibility in the field of information collection, storage, retrieval and dissemination.

The National Library Act, which came into force on September 1, 1969, provides that:

Subject to the direction of the Governor in Council the National Librarian may co-ordinate the library services of departments, branches and agencies of the Goverment of Canada including:

(a) the acquisistion and cataloguing of books;

(b) the supply of professional advice, supervision and personnel; and

(c) The provision of modern information storage and retrieval services including photocopying and microfilming services, electronic and other automated data processing services and facsimile or other communication of information services.

A Task Force established within the National Research Council approved the principal recommendations contained in the Science Council of Canada's Report No. 6 entitled "A Policy for Scientific and Technical Information Dissemination". A resulting NRC memorandum to Cabinet recommended that the NRC:

(a) Be assigned the responsibility for promoting the further development of a national network of scientific and technical information services to be built on existing resources.

(b) Create an Advisory Board to formulate general policies for scientific and technical information services and to provide guidance toward their implementation.

(c) Seek approval from the Treasury Board for a separate parliamentary vote to provide funds for the STI activity.

These requirements were approved by both the Cabinet Committee on Science Policy and Technology and the Cabinet Committee on Culture and Information. On December 19, 1969, the Cabinet stated that:

(a) pursuant to subsection 2 of section 7 of the National Library Act, the Governor in Council direct that the National Research Council, under the general direction of the National Librarian, develop in concert with existing information organizations, a national scientific and technical information system, to encompass the natural sciences and engineering:

(b) the National Research Couuncil be given approval to appoint for the above purposes an Advisory Board of Directors responsible for formulating general policies for scientific and technical information services in Canada and for guidance toward their implementation and that the National Library be given adequate representation on the Board;

(c) subject to the approval of Treasury Board, the STI operations of the National Research Council be funded through a separate parliamentary vote.

In July 1970, the National Research Council announced the appointment of an Advisory Board on Scientific and Technological Information to formulate broad policy guidelines for the continuing development of a national STI System in Canada. A special news release announcing the appointment of this Advisory Board is shown in Exhibit 8.

In compliance with the Statistics Act 1948 (an Act Respecting the Domion Bureau of Statistics) the duties of the Bureau include:

"(a) to collect, compile, analyse, abstract and publish statistical information relating to the commmercial, industrial, financial, social, economic and general activities and conditions of the people;

(b) to collaborate with other departments of the government in the collection, compilation and publication of statistical records of administration according to any regulations;

(c) to take the census of Canada as provided in this Act; and

(d) generally to organize a scheme of co-ordinated social and economic statistics pertaining to the whole of Canada and to each of the provinces thereof."

Obviously there is a wealth of data now available from the Bureau. Much of it would be invaluable if it was in data banks and could be utilized for social, economic and industrial planning by the private sector without infringement upon the confidential nature of data supplied by private persons or establishments or upon proprietary rights.

Because one of the major roles of the Federal Government is that of stimulating development a general approach was considered by the project team for the overall co-ordination and development of specific data banks. Various institutional arrangements were generated and examined by the team in respect to each particular sub-group. A number of significant thoughts must be posed as a result of these deliberations. Policy formulation must depend on as broad a base as possible for it is those generalities which provide a framework in which to develop the particular system. The alternative institutional arrangements generated by the project team are based on the following stated requirements:

(i) Overall planning and co-ordination

(ii) Federal catalytic leadership

(iii) Participation by related organizations in the private and quasi-private sectors

(iv) Participation wherever possible by the ultimate user.

In light of the above, three phases towards the actual establishment of data bank networks have been identified: planning, implementation, and operation. However one must recognize planning and implementation, although perhaps involving separate structures, are basically inseparable in terms of process. Operation may very well be considered as a separate function and process because distinct input-output processess must occur in order for the system to maintain itself and operate. In this light operation is conceptually distinct from planning and implementation.

As mentioned above structure may, within the two processes of planning-implementation and operation, vary according to the needs of each particular bank at each of the three phases. With this framework in mind it is possible to hypothesize a number of possible institutional structures which could be utilized at each of the three phases. This would not exclude the possibility of a monolithic structure which would carry out all three phases. The alternative structures are identified below:

(a) Status Quo-Laissez-faire

(b) Government Department(s) (Federal or Provincial)

(c) Intergovernmental Bodies (Federal, Provincial, Regional and/or Municipal)

(d) Crown Corporations (Federal or Provincial)

(e) Government Agency (Federal or Provincial)

(f) Government with Specialized Interest Groups (utilities, professions, etc.)

(g) Co-ordinating Agencies (Federally sponsored with interest group participation)

(h) Intergovernmental bodies and special interest groups

(i) Non profit groups

None of these structural alternatives are mutually exclusive. The resulting instituitional arrangement could well be a variant of any number of the structures posed. For example, no federal crown corporation would plan and implement data banks without regard for provincial governments or various interested groups whose actual support through participation is essential.

In the context of the Terms of Reference which set out the six major areas covered by this study, the matrix shown in Exhibit IX locates each area in terms of the most likely structure and process. Planning is of paramount importance, and one must consider in broad terms the degree of success which each of the nine proposed institutional arrangements might achieve in meeting a number of essential and desirable objectives of the planning phase as set out in this matrix. From the table it would appear that a Federal Government Agency (somewhat similar to the Science Secretariat) together with a national Advisory Committee (somewhat similar to the Science Council) would appear the most appropriate choice from the alternatives considered. Crown corporations offer conceptual advantages but, in terms of planning as opposed to operation, it is doubtful that a crown corporation would maximize this function. For example, crown corporations enjoy tax advantages and are operationally oriented. But since the accent is on operations the planning function may not be carried out as well as under an alternative institutional arrangement such as a government agency. In terms of a government department it is difficult to see how it could operate a national information retrieval system since it is so closely dependent upon government policy. It is clear from our sub-group reports that both planning and organizational autonomy are key elements in deciding upon institutional arrangements. Furthermore the selected institutional arrangements must also be able to accommodate a diversity of particular interest groups in order to implement systems with general support from those interests. This militates against the direct use of government departments. Therefore a body which can group the various interests is necessary. A consortium or group of interests organized along the lines of a government agency would seem to combine these desirable elements. Reference is made to this most important problem in the Resources Sector Report - that requirements will cut across present organizational barriers - resulting in their recommendation for a National Advisory Body with senior representation from all levels of government, from industry, and from the universities. Exhibit X, Hypothetical Organization Structure, presents a diagrammatic flow of the relationships surrounding the concept of a

National Advisory Body and includes terms of reference for the various committees shown in the structure. The left hand side of the chart pictures environmental influences on data bank planning and implementation while the right side shows the work flow resulting from these environmental inputs. It is essential to note that most arrows must be two-way, because at least informally, the data banks which emerge will have been profoundly influenced by environmental factors through such mechanisms as inter-departmental committees and the National Advisory Committee itself. The importance of the user, emphasized by all sub-groups, is maximized in this concept. Further desirable elements such as autonomy and integrative policy-making capabilities are also emphasized under such a proposed structure.

There is no question of the importance of the maximum interaction among the organizations affected in any plans to establish data banks. The role of a National Advisory Body would be to integrate these views as much as possible. However regardless of whether it is a specific government department or an agency which implements data banks the role of government is to stimulate and advise rather than solely to control. For example, Industry, Trade and Commerce has been involved in the establishment of the BEAM* construction information system. The processes involved in BEAM show very clearly the phases involved in bringing these systems into operation as well as indicating a possible role for government. The first step in this development was to undertake a feasibility study to identify the existing methods of storing, retrieving and disseminating information and to define the needs and requirements of both users and suppliers of construction data. The results of this study were to either justify the establishment of a data network or to indicate its excessive cost rather than saving. Economic efficiency was a prime criterion. The following conclusions were arrived at after an analysis of this information by officers of the Department of Industry, Trade and Commerce.

(a) The role of the Department of Industry, Trade and Commerce should be that of a catalyst exhibiting initial leadership, guidance and assistance in the development and establishment of a comprehensive construction information system.

* BEAM - Building Equipment Accessories and Materials.

(b) The Department should develop the performance specification for the system.

(c) The Department should actively seek, in association with industry, the formation of an independent, non-profit, financially responsible corporation (or similarly constituted body) having a board of directors representative of the various industry sectors and government.

(d) This corporation should have the authority and financial ability to establish, operate and provide for the continued development of the construction information system.

In effect, through the planning and implementation phases government participation in the enterprise is emphasized. However, the institutional arrangement alters as the operations phase begins the result being an independent co-ordinating body.

Once a need has been established for a specific data bank the approach to be taken in its development and implementation will depend on several factors, including:

(a) User requirements

(b) User acceptance

(c) Present state of the art in the particular field

(d) Resources available

(e) Benefits to be derived

(f) Costs and revenue

(g) Co-ordiantion with other data banks

(h) Problems of data collection and validation.

In spite of the wide variety of problems and requirements historically there appears to be a general pattern in those systems presently operational or under development. The pattern follows from an initial exploratory phase through a conceptual phase and a design phase to the implementation phase. The degree of success achieved by this pattern recommends it as one to be followed in future developments.

There will be many competing demands for resources in the development of data banks. Some effective organizational structure must exist for assessing relative priorities on a national scale. The concept of the National Advisory Body, since its role is to integrate competing demands, deserves further discussion in the context of the above noted pattern of development. Six phases have been noted through past experience:

(1) The Exploratory Phase

(2) The Conceptual Phase

(3) The Design Phase

(4) The Implementation Phase

(5) The Operational Phase

(6) The Audit Phase

Generally, these six phases correspond to the process approach discussed above.

Planning →	Exploratory Phase Conceptual Phase
Implementation →	Design Phase Implementation Phase
Operation →	Operational Phase Audit Phase

1. <u>The Exploratory Phase</u>

The importance of user-orientation of a data bank cannot be over-emphasized. It is therefore essential at the outset to ascertain the interest of potential users and to discuss requirements and the desirability of a national or regional system with them. The national body recommended above would stimulate initial discussions of this type.

Full user support and participation is essential to the success of most ventures and this is especially true in information systems if we are to develop a volume market. In areas of significant national importance it may be necessary to expend considerable resources, time and effort in advertising, explaining and possibly demonstrating the individual and collective benefits to be derived before it is possible to proceed with the development of a particular bank. The exploratory stage could conceivably be quite broad and extensive for the early data banks but should

become more specific and less extensive as the public become aware of and accepts the concepts of information systems.

2. The Conceptual Phase

A formalized conceptual phase follows the ad-hoc exploratory phase. In this second step there is need for a senior Co-ordianting Committee for resolving problems of a 'strategic' nature including, for example, those related to Federal-Provincial jurisdictions and those related to financial requirements. In addition there should be a Working Committee at the 'tactical' level for considering problems of a more technical and social nature.

The Working Committee should consist of persons vitally and directly concerned with making use of information from the proposed data bank and should include at least one person with technical knowledge and experience in computing and systems design or, at least, have such people available as consultants. This Committee must define the specific requirements for the proposed data bank including consideration of the following points:

- User requirements in regard to file processing capability.
- Allocation of responsibilities for data content, data structure, data validity, file maintenance, program development and maintenance, etc., and recommendation as to management and responsibility for the complete system.
- Standardization and compatibility of data files.
- Standards for programming and systems compatibility.
- Data security and authority for access.
- Types of access, communications requirements and response time.
- Staff requirements for development and maintenance.
- Costs of development and operation
- Implementation schedule of the total program.

Any temptation to include everything which <u>might</u> be useful should be strongly resisted. Objectives should be kept to a realistic level so that a working system may be obtained in a

reasonable time frame. It is however important to provide sufficient flexibility for future growth.

Responsibility and authority, for development through this phase should reside in a small "kernel" group -- possibly headed by a member of the Co-ordinating Committee. Acceptance of the general plan of the data bank program is essential prior to proceeding to the next phase.

3. The Design Phase

An important problem here is lack of sufficient staff with the necessary high level of expertise and experience in government and other organizations which may assume responsibility for developing and operating "national" data banks. The problem may be resolved by the use of commercial consultants. However, with increasing demands for data banks this may not be the most economical and effective method of using available resources. Consideration should be given to establishing in government a group of high calibre systems analysts specifically for this work. This group could form part of the permanent staff to support the national advisory body recommended above. Terms of reference are suggested in Exhibit X.

Some or all of the members of these technical goups may be drawn, part-time, from operating computer facilities and related systems groups in government and industry to ensure retention of active contact with this highly technological industry.

The systems group would evaluate generalized data base management systems on the market in terms of the specific requirements of individual systems. A pool of this type of expertise would be extremely valuable and would tend to reduce development time on specific systems. In designing different specific systems common problems and their solutions would become evident and "building block" components could be developed with fairly general utitlity.

Attempts to achieve generality of this type must not detract from the overriding user-orientation of the system, nor should they reach a level of importance where there are resulting delays in system implementation.

In cases where access to the system is frequent and where there are a large number of widely scattered users particular attention must be given in this phase to modes of input and output.

If insufficient consideration is given to this problem the economics of the system could be seriously affected.

In addition to setting up a systems group to provide a high level of expertise in government on information retrieval systems consideration should also be given to encouraging growth of centres of excellence in this field in Canadian universities by giving government contracts to these centres. This procedure has met with success in the United States.

This would result in a number of important side benefits. One of these would be to encourage closer co-operation between industry and universities because industry would follow with contracts in this area. It would also provide increased training for skilled personnel where demand far exceeds supply.

4. The Implementation Phase

This is the phase which proves the systems designed in phase 3; it includes the conversion from a manual method to an automated one, the education of operators and users, etc. It is in the implementation phase that wider differences in approach are liable to arise. The approach will depend largely on the use that will be made of the data bank -- for planning, service, control or research -- and on the type of users -- Federal, Provincial, Municipal Administrations, industry, universities or individuals. Any special security requirements will also place restrictions on the approach to be taken.

It is desirable that at least one of the analysts in the design phase of a given system should retain some responsibility and authority for the implementation phase. Many problems will be eliminated by maintaining this link.

Lack of sufficient trained staff to meet requirements is again a problem. The problem could be lessened by pooling programming resources from a number of interested users, by early recruitment of many additional permanent staff recommended by the Working Committee, or by use of commercial consulting services.

It is important in this phase to attempt to make the system as machine-independent as possible. This will provide greater flexibility by permitting extension of the system to other hardware configurations and by allowing relatively easy updating of the system to take advantage of new improvements in hardware capabilities as they become feasible.

5. The Operational Phase

In the systems now operating or in the final stages of implementation where Federal Government financing is involved there are few definite plans to transfer operations to non-government agencies. The project team is of the opinion that there could be considerable merit in taking this approach under certain conditions.

Criteria have not been established for assesssing the most appropriate means of operating a data bank nor for assessing the effectiveness and efficiency of the operational phase. It is suggested that the national body should develop such sets of criteria and further suggest the following points for consideration:

(a) The data bank should be run economically on a cost accounting basis. If the data are required under regulatory acts of Parliament or for some other special purpose where charges for services cannot be made the economics of the system may be difficult to assess. Minimization of costs, commensurate with providing adequate and accurate data in the necessary time frame, is perhaps the major consideration.

(b) Costing should include all overheads, such as office space, lighting, heating, etc., as well as salaries (part-time as well as full-time), and computer/communications costs.

(c) Where data does not present a security risk consideration should be given to the operation of national data banks by non-government agencies, such as industry, or trade associations, to be run on a profit basis.

In such circumstances it would be necessary to ensure that the data and the software developed by the government for the operation of the information systems would remain the property of the government.

(d) Measures to encourage use of the bank should be considered, for example, lower charges initially

during the educational and user build-up phase of operations. This would probably require government subsidy in the early stages.

(e) Appropriate procedures for allowing access to the data bank and for protecting privacy.

(f) Measures for ensuring continuity of service and for monitoring the system's performance.

6. The Audit Phase

Audit as it applies to a data bank is part of the Operational Phase and must be a function of management. It envisages internal rather than external responsibility. The audit should ensure that the system does not become clogged with data unsuitable for decision-making in the current environment; that unused data is re-evaluated and taken out of the system if it is not relevant; that users have not perverted the programs in the system and used them to further unaceptable activities; and that the system is in fact being used.

A consideration of these points will lead to a need for legislation to cover certain aspects of the operation of data banks. Recommendations on the required legislation would be one of the first responsibilities of the Advisory Body in order to prevent misuse and misappropriation of government property.

In an attempt to construct an overview of what has been said above two themes come clearly to mind. The actual process of creating data bank networks is a multi-phased effort which may involve differing institutional arrangements, at least between the planning -- implementation process and the operations process. Secondly, the institutional arrangement most acceptable during the curcial planning -- implementation process must be able to integrate diverse affected interests with the purpose of emerging with a uniform national policy on data banks. Exhibit X attempts to portray such a relationship among these interests within a proposed institutional structure, that of a government agency taks force composed of representatives from government, industry and the universities. In this sense there is a consortium of interests able to integrate the views of these affected groups or individuals to develop coherent approaches.

In terms of data bank development it is very important to apply an approach similar to the one summarized above. This is because of the

potentially high expenditures of resources in such an undertaking. Unnecessary features and errors must be minimized in these endeavours and the phased approach, since it implies justification at each stage, is more able to minimize the effects of these possible events.

TABLE OF CONTENTS FOR EXHIBITS

TERMS OF REFERENCE FOR A STUDY OF THE INSTITUTIONAL ARRANGEMENTS FOR OPTIMIZING THE DEVELOPMENT OF DATA BANKS IN THE PUBLIC INTEREST

GENERAL OBJECTIVES

To identify national information services in the public interest which could be supplied by large remote access data banks and to develop and analyse possible institutional arrangements for their development, implementation and operation.

SPECIFIC TERMS OF REFERENCE

The numerical ordering of the following items does not imply that the studies will be performed sequentially. Obviously item 3 must proceed in parallel with item 2 and portions of item 6, although item 6 really represents the final output of this study.

(1) To identify families of areas where data banks could serve in the public interest:

For example:-

- transfer of knowledge
- resources
- professional
- financial
- urban affairs
- etc.

(2) Identify technological, institutional, political, legal, and other factors and characteristics which may influence the development and implementation of these systems.

(3) Examine the need for and analyze conceptual designs of possible systems capable of providing services for each of the family areas chosen. These will include but will not necessarily be confined to law, medicine, industry, and resources.

(4) Consider the economics of such systems.

(5) Identify the support necessary to establish and maintain these data banks.

(6) Identify, describe, and examine critically the international arrangements for developing, acquiring, and operating these systems.

Notes:

(a) Project team members will attempt to coordinate the activities of this study with existing studies relative to this area.

(b) The Scientific and Technical Information (STI) Study has been assigned to the National Research Council (NRC). Information relevant to the Telecommission Data Bank Study 5f will be requested from the NRC Board of Directors responsible for the implementation of the STI System.

(c) The following definitions form part of the Terms of Reference for this study:

Data

Data is defined as a record of observations or notations which have common characteristics.

Data file

The data file is defined as a set of data.

Data base

Is a set of related data files.

Data bank

A data bank is a system by which the data in the data base can be easily stored, maintained, retrieved and manipulated.

In the public interest refers to

the concern the public of Canada has that any matter or thing be open to the common or general use, enjoyment, knowledge or view of all Canadians in the national interest.

In the national interest refers to

the concern of Canadians with matters or things that affect institutions, customs or objectives of the body politic, and the mutual interests of Canadians as an independent state in the Community of Nations.

Institutional means

anything pertaining to an organization, establishment, foundation, society, or the like, devoted to the promotion of a particular object, especially one of a general, public, educational or charitable character.

Institutional arrangements

Institutional arrangements refers to the organizational, management and financial structures required for promoting, developing and administering data banks in the public interest. It also includes consideration of the appropriate policies and roles of relevant government, professional and private organizations.

PROJECT TEAM

TELECOMMISSION STUDY 5F

Resources:
- W.C. Brown, National Research Council
- R.F. Bullen, Representing the National Librarian
- Dr. L.A.E. Doe, C.I.D.A.
- Dr. H. Kaufman, Science Council of Canada
- Dr. P. Robinson, Department of Agriculture
- U.C.P. Strahlendorf, Bell Canada

Medical:
- Dr. A. Sherrington, Department of National Health & Welfare

Urban:
- Miss M. Ouellette, Canadian Council on Urban and Regional Research (liaison officer only)

Consumers:
- Mrs. G. Stewart, Consumers Association of Canada

Legal:
- J.W. Ryan, Department of Justice
- Prof. J. Boucher, University of Montreal
- Prof. G. Forget, Laval University
- Prof. H. Lawford, Queen's University
- S. Skelly, Department of Justice

Industry:
- J.P.I. Tyas, Department of Industry, Trade and Commerce
- H.F. Hannay, Northern Electric Company Limited
- Miss C. Kirsh, Canadian Manufacturers Association (Southam Press)
- G.D. Wynd, Canadian Business Equipment Manufacturers Association

Departmental Liaison Officers:
- J.S. Crowson (Chairman)
- W.R. Melbourn
- D.F. Parkhill

DEPARTMENT OF COMMUNICATIONS

CANADA

MINISTÈRE DES COMMUNICATIONS

IN REPLY QUOTE:
RÉF. À RAPPELER:

Dear Sir:

With a view to furthering the concept expressed in Mr. Gotlieb's letter, I would like to ask your association to assist this study.

There are three major types of information services which it is thought could be extremely useful to industry.

(1) Development of a referral service, accessible from any part of Canada, through which industry could identify sources of information and of expertise on specific scientific, engineering, technical and economic matters. ("The Yellow Pages").

(2) Development of industrial mission-oriented information services for specific industrial sectors operated by the industries concerned, e.g. the Construction Industry Information System included in the BEAM Program. (see attached sheet)

(3) Development of technology transfer services through which industry could seek information and advice locally on the availability and application of new technology. This would include, wherever desirable, special field services similar to those presently supplied by the Technical Information Service of N.R.C.

.../2

It would be of great assistance to this study if your association would:

(a) Indicate the usefulness of such services.

(b) What priority and importance do you attach to the setting up of such services?

(c) Would your association be prepared to support such services?

Due to our tight time schedule, a reply would be appreciated by the end of April 1970.

Yours sincerely,

J.S. Crowson

J.S. Crowson,
Information Systems Consultant,
National Telecommunications Branch.

Att.

Questionnaires were sent to the following:

* Allied Boating Association

* Apparel Manufacturers Council of Canada

Association of Canadian Distillers

Association of Consulting Engineers of Canada

* Automotive Parts Manufacturers Association (Canada)

Bakery Council of Canada

* Brewers Association of Canada

Canadian Carpet Institute

Canadian Chemical Products Association

* Canadian Council of Furniture Manufacturers

Canadian Council of Professional Engineers

Canadian Electrical Manufacturers Association

Canadian Farm and Industrial Equipment Institute

* Canadian Gas Association

Canadian Institute of Plumbing and Heating

Canadian Paint Manufacturers Association

* Canadian Paper Box Manufacturers Association

Canadian Pharmaceutical Association

Canadian Pulp and Paper Association

The Canadian Seed Growers Association

* Canadian Shipbuilding and Ship Repairing Association

Canadian Truck Trailer Manufacturers

Canadian Textiles Institute

Canadian Toy Manufacturers Association

Canadian Wood Council

The Chemical Institute of Canada

Childrens Apparel Manufacturers Association

Confectionery Association of Canada

* Electronic Industries Association of Canada

* The Engineering Institute of Canada

Glass Containers Council

* Graphic Arts Industrial Association

* Machine and Equipment Manufacturers Association

Motor Vehicle Manufacturers Association

Packaging Association of Canada

Pharmaceutical Manufacturers Association of Canada

The Rubber Association of Canada

Shoe Manufacturers Association

Society of Industrial Cost Accountants of Canada

The Society of Plastic Industry of Canada

Wood Textile Association of Canada

* Replies were received from these associations.

QUESTIONNAIRE ON THE METHODS OF SEARCHING CASE LAW AND STATUTE LAW

1. AT THE MOMENT, IN WHICH ONE OF THE FOLLOWING AREAS OF THE LAW ARE YOU PRINCIPALLY ENGAGED?

(1) BARRISTER
(2) SOLICITOR
(3) FULL-TIME PROFESSOR
(4) POST GRADUATE LAW STUDENT

2. DO YOU PRACTICE LAW

(1) FOR THE FEDERAL GOVERNMENT?
(2) FOR A PROVINCIAL GOVERNMENT?
(3) IN A COMPANY?

IN PRIVATE PRACTICE

(4) ALONE?
(5) IN AN OFFICE OF 2 TO 4 PRACTITIONERS?
(6) IN AN OFFICE OF 5 TO 9 PRACTITIONERS?
(7) IN AN OFFICE OF 10 to 19 PRACTITIONERS?
(8) IN AN OFFICE OF 20 OR MORE PRACTITIONERS?

3. WHERE IS YOUR OFFICE SITUATED?

(1) METROPOLITAN AREA
(2) SUBURBS (RADIUS OF 10 MILES) OF A METROPOLITAN AREA
(3) CITY
(4) TOWN

4. IS YOUR PRACTICE

(1) GENERAL?
(2) SPECIALIZED?

5. WHETHER YOUR PRACTICE IS GENERAL OR SPECIALIZED INDICATE AT THE MOST THREE CATEGORIES WHICH YOUR PRACTICE PRINCIPALLY INCLUDES.

(1) DIVORCE AND MATRIMONIAL AFFAIRS
(2) AUTOMOBILE ACCIDENTS
(3) CRIMINAL
(4) CORPORATIONS
(5) TAX
(6) LABOUR
(7) INSURANCE
(8) PATENTS AND COPYRIGHT
(9) TRANSPORTATION
(10) MUNICIPAL, SCHOOL.
(11) ADMINISTRATIVE
(12) EXPROPRIATIONS

5. Continued....

(13) BANKRUPTCY
(14) REAL PROPERTY
(15) ESTATES (INCLUDING TRUSTS AND WILLS)
(16) COLLECTION
(17) OTHER

6. FOR HOW MANY YEARS HAVE YOU PRACTICED YOUR PRESENT PROFESSION?

(1) 0 - 2
(2) 3 - 5
(3) 6 - 10
(4) 11 - 20
(5) 21 - or more

7. WHERE DID YOU OBTAIN YOUR FIRST DEGREE IN LAW?

(1) IN THE PROVINCE IN WHICH YOU PRACTICE
(2) IN ANOTHER PROVINCE
(3) OUTSIDE CANADA

8. AT THE PRESENT MOMENT, IN WHAT PROPORTION OF YOUR FILES DO YOU CONSULT CASES, STATUTES, REGULATIONS (MUNICIPAL, PROVINCIAL, FEDERAL), AND TEXTS (INCLUDING ABRIDGEMENTS, DIGESTS, ETC)?

	Cases	Statutes	Regulations	Texts
(1) IN LESS THAN 10% OF THE FILES				
(2) BETWEEN 10 and 25%				
(3) BETWEEN 25 and 50%				
(4) MORE THAN 50%				

9. IF THE RELEVANT INFORMATION WERE IMMEDIATELY ACCESSIBLE WOULD YOU CONSULT THESE SOURCES MORE FREQUENTLY?

(1) YES
(2) NO

Cases	Statutes	Regulations	Texts

10. DURING WHICH HOURS OF THE DAY DO YOU USUALLY CARRY OUT YOUR LEGAL RESEARCH (FILL IN MORE THAN ONE BOX, OR LEAVE EMPTY BOXES IF NECESSARY)

(1) 8h - 9h
(2) 9h - 10h
(3) 10h - 12h

10. continued

(4) 12h - 14h
(5) 14h - 15h
(6) 15h - 16h
(7) 16h - 17h
(8) 17h - 19h
(9) AFTER 19h

11 INDICATE WHICH OF THE FOLLOWING INDEXES YOU CONSULT MOST OFTEN IN THE ORDER OF FREQUENCY CONSULTED (FILL IN MORE THAN ONE BOX OR LEAVE EMPTY BOXES IF NECESSARY)

(1) A provincial statute citator
(2) The Canada Statute Citator
(3) The Canadian Abridgment
(4) Index to Revised Statutes of Province
(5) Index to Revised Statutes of Canada
(6) Index to Canada Gazette, Part II
(7) Index to Official Gazette of the Province

MOST FREQUENTLY

LEAST FREQUENTLY

12. HOW MANY HOURS A WEEK DO YOU PERSONALLY SPEND ON LEGAL RESEARCH?

(1) LESS THAN FIVE HOURS
(2) BETWEEN 6 AND 10 HOURS
(3) BETWEEN 11 and 20 HOURS
(4) MORE THAN 21 HOURS

13. DO YOU DELEGATE SOME OF YOUR LEGAL RESEARCH TO OTHER PERSONS?

(1) YES

(2) NO

14. WHO AND HOW MANY PERSONS CARRY OUT THIS LEGAL RESEARCH FOR YOU (INDICATE THE NUMBER OF PERSONS IN THE APPROPRIATE BOX)

COLLEAGUES ....
LAW STUDENTS...
OUTSIDE COUNSEL ....
OTHERS (LIBRARIANS, ETC.) ....

15. HOW MANY HOURS A WEEK DO THESE PERSONS SPEND ON AN AVERAGE CARRYING OUT THIS LEGAL RESEARCH?

(1) NIL
(2) LESS THAN 5 h.
(3) BETWEEN 5h and 10h.
(4) BETWEEN 10h and 20 h.
(5) MORE THAN 20h.

COLLEAGUES ....
LAW STUDENTS ....
OUTSIDE COUNSEL ....
OTHERS (LIBRARIANS, ETC.) ....

16. IN WHAT LIBRARY IS MOST OF THIS LEGAL RESEARCH CARRIED OUT?

(1) PRIVATE OR OFFICE LIBRARY
(2) UNIVERSITY LIBRARY
(3) PUBLIC LIBRARY (BAR, SUPREME COURT, LEGISLATURE, ETC.)

17. DO YOU HAVE YOUR OWN LIBRARY?

(1) YES

(2) NO

18. IF YES, DOES YOUR OWN LIBRARY INCLUDE THE FOLLOWING SERIES:

(1) YES, COMPLETE
(2) YES, COMPLETE FROM 1950
(3) YES, INCOMPLETE
(4) NO

ECR (EXCHEQUER COURT REPORTS) ....

SCR (SUPREME COURT REPORTS) ....

DLR (DOMINION LAW REPORTS)...........................

CCC (CANADIAN CRIMINAL CASES) ....

C.R.(CRIMINAL REPORTS) ....

C.T.C. (CANADIAN TAX CASES) ....

T.A.C. (TAX APPEAL BOARD CASES) ....

Canadian Bankruptcy Reports ....

CBR (CANADIAN BAR REVIEW) ....

R.S. (REVISED STATUTES OF CANADA)...................

18. Continued .....

R.S.C. (Revised Statutes of Canada) ....

THE CANADA STATUTE CITATOR ....

THE CANADIAN ABRIDGMENT ....

OFFICIAL GAZETTE OF PROVINCE ....

CANADA GAZETTE, PART I ....

CANADA GAZETTE, PART II ....

19. IN ANY REPLY FURNISHED BY AN AUTOMATED LEGAL RESEARCH SYSTEM IN JURISPRUDENCE, WHICH OF THE FOLLOWING DETAILS WOULD YOU CONSIDER INDISPENSABLE?

(1) YES
(2) NO

THE EXACT REFERENCE (E.G. 1966 SCR 343)

THE NAME OF THE PARTIES

THE KEY-WORDS FRAMEWORK AS PUBLISHED IN THE SCR

THE NAMES OF THE JUDGES AND DATE OF JUDGMENT

THE NAMES OF THE COUNSEL WHO PLEADED THE CASE

INDICATION IF JUDGMENT RENDERED IN DEFAULT, EX PARTE OR CONTESTED ACTION

THE PAGE AND PARAGRAPH WHERE THE REQUESTED INFORMATION IS FOUND

THE SUMMARY OR "HEADNOTE" OF THE CASE AS PUBLISHED IN THE REPORTS

20. IN ANY REPLY FURNISHED BY AN AUTOMATED LEGAL RESEARCH SYSTEM IN LEGISLATION, WHICH OF THE FOLLOWING DETAILS WOULD YOU CONSIDER INDISPENSABLE?

(1) YES
(2) NO

THE REFERENCE TO THE CHAPTER, SECTION AND PARAGRAPH OF THE ACT

THE OFFICIAL TITLE OF THE ACT

THE FULL TEXT OF THE ACT

THE TEXT OF THE ACT AS REVISED TO DATE

THE REFERENCES TO REGULATIONS

THE FULL TEXT OF THE REGULATIONS

21. ARE YOU INTERESTED IN FOLLOWING SYSTEMATICALLY THE BILLS INTRODUCED IN ANY LEGISLATURE STARTING FROM FIRST READING?

(1) YES

(2) NO

TITLE SEARCHING IN THE REGISTRY OFFICES

22. DO YOU CARRY OUT TITLE SEARCHING IN THE REGISTRY OFFICES?

(1) YES

(2) NO

IF YOU ANSWERED QUESTION 22 IN THE AFFIRMATIVE, PLEASE REPLY TO QUESTIONS 23 TO 26.

23. ON AN AVERAGE, HOW MANY TIMES PER MONTH DO YOU PERSONALLY ATTEND THE REGISTRY OFFICES?

(1) 2 OR LESS HOURS
(2) 3 TO 5
(3) 6 TO 10
(4) MORE THAN 11

24. HOW MANY HOURS PER MONTH DO YOU SPEND AT THE REGISTRY OFFICE?

(1) 1 TO 5 HOURS
(2) 6 TO 10
(3) 11 to 20
(4) MORE THAN 21

25. APPROXIMATELY HOW FAR FROM YOUR OFFICE IS THE REGISTRY OFFICE OF YOUR DISTRICT?

(1) BETWEEN A RADIUS OF 10 MILES

(2) BETWEEN 10 and 25 MILES

(3) MORE THAN 25 MILES

26. WHAT PROPORTION OF YOUR TITLE SEARCHING DO YOU CARRY OUT AT THE REGISTRY OFFICE IN YOUR DISTRICT?

(1) 100% IN YOUR DISTRICT

(2) BETWEEN 100 AND 75%

(3) BETWEEN 75 AND 50%

(4) LESS THAN 50%

QUEBEC BAR QUESTIONNAIRE

Questionnaire sur les méthodes de consultation de la jurisprudence et de la législation.

QUESTIONNAIRE ON THE METHODS OF SEARCHING CASE LAW AND STATUTE LAW.

1. Quelle est présentement votre principale activité juridique?
AT THE MOMENT, IN WHICH ONE OF THE FOLLOWING AREAS OF THE LAW ARE YOU PRINCIPALLY ENGAGED?

(1) Juge JUDGE
(2) Avocat LAWYER
(3) Notaire NOTARY
(4) Professeur de carrière FULL-TIME PROFESSOR
(5) Etudiant post-gradué en droit POST GRADUATE LAW STUDENT

....

2. Si vous êtes avocat ou notaire, exercez-vous le droit?
IF YOU ARE A LAWYER OR NOTARY, DO YOU PRACTICE LAW?

(1) pour le gouvernement fédéral
FOR THE FEDERAL GOVERNMENT

(2) pour le gouvernement provincial
FOR THE PROVINCIAL GOVERNMENT

(3) dans une corporation
IN A COMPANY

dans une étude privée
IN PRIVATE PRACTICE

(4) seul
ALONE

(5) dans un bureau de 2 à 4 juristes
IN AN OFFICE OF 2 TO 4 PRACTITIONERS

(6) dans un bureau de 5 à 9 juristes
IN AN OFFICE OF 5 TO 9 PRACTITIONERS

(7) dans un bureau de 10 à 19 juristes
IN AN OFFICE OF 10 TO 19 PRACTITIONERS

(8) dans un bureau de 20 juristes et plus
IN AN OFFICE OF 20 OR MORE PRACTITIONERS

3. A quel endroit se situe votre bureau?
WHERE IS YOUR OFFICE SITUATED?

(1) Montréal, centre-ville
MONTREAL, CENTRE OF TOWN

(2) Montréal, banlieue (rayon de 10 milles)
MONTREAL, SUBURBS (RADIUS OF 10 MILES)

(3) Région de Québec (rayon de 10 milles)
QUEBEC CITY AREA (RADIUS OF 10 MILES)

(4) Ailleurs
ELSEWHERE

4. Votre pratique est-elle
IS YOUR PRACTICE

(1) générale
GENERAL

(2) spécialisée
SPECIALIZED

....

5. Que votre pratique soit générale ou spécialisée, indiquez <u>au plus les trois</u> domaines sur lesquels elle porte principalement.
WHETHER YOUR PRACTICE BE GENERAL OR SPECIALIZED INDICATE <u>AT THE MOST THREE</u> CATEGORIES WHICH YOUR PRACTICE PRINCIPALLY INCLUDES

(1) civil
(2) accidents d'automobiles AUTOMOBILE ACCIDENTS
(3) criminel CRIMINAL
(4) compagnies COMPANIES
(5) fiscal TAX
(6) travail LABOUR
(7) assurances INSURANCE
(8) brevets et droits d'auteurs PATENTS AND COPYRIGHT
(9) transports TRANSPORTATION
(10) municipal, scolaire, fabricien MUNICIPAL, SCHOOL, PARISH
(11) administratif ADMINISTRATIVE
(12) expropriations
(13) faillite BANKRUPTCY
(14) transactions immobilières IMMOVEABLE PROPERTY
(15) droit successoral SUCCESSIONS
(y compris de fiducie) (INCLUDING TRUSTS)
(16) perception de comptes COLLECTION
(17) autres OTHER

6. Depuis combien d'années exercez-vous votre profession actuelle?
FOR HOW MANY YEARS HAVE YOU PRACTICED YOUR PRESENT PROFESSION?

(1) 0 - 2
(2) 3 - 5
(3) 6 - 10
(4) 11 - 20
(5) 21 - et plus
OR MORE

....

7. Quelle est votre langue maternelle?
WHICH IS YOUR MOTHER TONGUE?

(1) anglais ENGLISH
(2) français FRENCH
(3) autre OTHER

8. Où avez-vous obtenu votre premier diplôme en droit?
WHERE DID YOU OBTAIN YOUR FIRST DEGREE IN LAW?

(1) Montréal
(2) Laval
(3) McGill
(4) Sherbrooke
(5) Ottawa
(6) autres OTHER

....

9. Actuellement dans quelle proportion de vos dossiers consultez-vous la jurisprudence, les statuts, les règlements (municipaux, provinciaux, fédéraux), et la doctrine?
AT THE PRESENT MOMENT IN WHAT PROPORTION OF YOUR FILES DO YOU CONSULT JURISPRUDENCE, STATUTES, REGULATIONS (MUNICIPAL, PROVINCIAL, FEDERAL), AND DOCTRINE?

	Jurisprudence	Statuts Statutes	Réglements Regulations	Doctrine
(1) dans moins de 10% des dossiers IN LESS THAN 10% OF THE FILES				
(2) entre 10 et 25% BETWEEN 10 AND 25%				
(3) entre 25 et 50% BETWEEN 25 AND 50%				
(4) plus de 50% MORE THAN 50%				

10. Si tous les renseignements utiles étaient immédiatement disponibles, consulteriez-vous ces sources plus fréquemment?
IF THE RELEVANT INFORMATION WERE IMMEDIATELY ACCESSIBLE WOULD YOU CONSULT THESE SOURCES MORE FREQUENTLY?

	Jurisprudence	Status Statutes	Doctrine
oui YES			
non NO			

11. A quelles heures de la journée faites-vous surtout votre recherche (indiquez plus d'une case, laissez des cases vides si nécessaire)
DURING WHICH HOURS OF THE DAY DO YOU USUALLY CARRY OUT YOUR LEGAL RESEARCH (FILL IN MORE THAN ONE BOX, OR LEAVE EMPTY BOXES IF NECESSARY)

(1) 8h - 9h
(2) 9h - 10h
(3) 10h - 12h
(4) 12h - 14h
(5) 14h - 15h
(6) 15h - 16h
(7) 16h - 17h
(8) 17h - 19h
(9) aprés 19h AFTER

1 ☐ 2 ☐ 3 ☐

12. Indiquez, dans l'ordre, les index que vous consultez le plus fréquemment (indiquez plus d'une case ou laissez des cases vides si nécessaire)
INDICATE WHICH OF THE FOLLOWING INDEXES YOU CONSULT MOST OFTEN IN THE ORDER OF FREQUENCY CONSULTED (FILL IN MORE THAN ONE BOX OR LEAVE EMPTY BOXES IF NECESSARY)

(1) Gagnon Index Gagnon ☐

(2) Annuaire de jurisprudence du Québec (Lévesque, St-Cyr, Beauchamp) ☐

(3) The Canada Statute Citator ☐

(4) The Canadian Abridgment ☐

(5) Index des statut refondus du Québec
Index to Revised Statutes of Quebec ☐

(6) Index des statuts revisés du Canada
Index to Revised Statutes of Canada ☐

(7) Index de la Gazette du Canada partie 2
Index to Canada Gazette, Part 2 ☐

(8) Index de la Gazette Officielle du Québec
Index to Quebec Official Gazette

13. Combien d'heures par semaine consacrez-vous à la recherche légale?
HOW MANY HOURS A WEEK DO YOU PERSONALLY SPEND ON LEGAL RESEARCH?

(1) moins de cinq heures LESS THAN FIVE HOURS
(2) entre 6 et 10 heures BETWEEN 6 AND 10 HOURS
(3) entre 11 et 20 heures BETWEEN 11 AND 20 HOURS
(4) plus de 21 heures MORE THAN 21 HOURS

14. Déléguez-vous certaines de vos recherches à d'autres personnes?
DO YOU DELEGATE SOME OF YOUR LEGAL RESEARCH TO OTHER PERSONS?

(1) Oui YES
(2) Non NO

....

15. Qui et combien de personnes effectuent pour vous ces recherches? (Dans la case correspondante, indiquez le nombre de personnes.)
WHO AND HOW MANY PERSONS CARRY OUT THIS LEGAL RESEARCH FOR YOU? (INDICATE THE NUMBER OF PERSONS IN THE APPROPRIATE BOX)

collegues COLLEAGUES .... [ ]
stagiaires et étudiants LAW STUDENTS .... [ ]
consultants OUTSIDE COUNSEL .... [ ]
autres (bibliothécaire, etc.) OTHERS (LIBRARIANS, ETC.).. [ ]

....

16. Combien d'heures par semaine ces personnes ou groupe de personnes consacrent-elles en moyenne à faire vos recherches?
HOW MANY HOURS A WEEK DO THESE PERSONS SPEND ON AN AVERAGE CARRYING OUT THIS LEGAL RESEARCH?

(1) nil
(2) moins de 5h LESS THAN 5h
(3) entre 5h et 10h BETWEEN 5h AND 10h
(4) entre 10h et 20h BETWEEN 10h AND 20h
(5) plus de 20h MORE THAN 20 HOURS

collègues COLLEAGUES .... [ ]
stagiaires et étudiants LAW STUDENTS .... [ ]
consultants OUTSIDE COUNSEL .... [ ]
autres (bibliothécaires, etc.) OTHERS (LIBRARIANS,ETC. [ ]

17. Dans quelle bibliothèque ces recherches sont-elles principalement faites?
IN WHAT LIBRARY IS MOST OF THIS LEGAL RESEARCH CARRIED OUT?

(1) bibliothèque privée
PRIVATE OR OFFICE LIBRARY

(2) bibliothèque universitaire
UNIVERSITY LIBRARY

(3) bibliothèque publique (Barreau, Cour Suprême, Législature,etc)
PUBLIC LIBRARY (BAR, SUPREME COURT, LEGISLATURE, ETC.)

18. Avez-vous une bibliothèque privée?
DO YOU HAVE YOUR OWN LIBRARY?

(1) Oui YES
(2) Non NO

....

19. Si oui, votre bibliothèque privée comprend-elle les séries suivantes:
IF YES, DOES YOUR OWN LIBRARY INCLUDE THE FOLLOWING SERIES:

(1) Oui, complète YES, COMPLETE
(2) Oui, complète depuis 1950 YES, COMPLETE FROM 1950
(3) Oui, incomplète YES, INCOMPLETE
(4) Non, NO

RCS/SCR (Cour Suprême - SUPREME COURT)............ ☐

BR/QB (Banc de la Reine - QUEEN'S BENCH) .... ☐

CS/SC (Cour Supérieure - SUPERIOR COURT) .... ☐

RP (Rapports de Pratique) .... ☐

RL (Revue Légale) .... ☐

CE/EC (Echiquier - EXCHEQUER COURT) .... ☐

DLR (Dominion Law Reports) .... ☐

C.C.C. (Canadian Criminal Cases) .... ☐

C.R. (Criminal Reports) .... ☐

R.D.T. (Revue de droit du Travail) .... ☐

C.T.C. (CANADIAN TAX CASES) .... ☐

T.A.C. (TAX APPEAL BOARD CASES) .... ☐

Canadian Bankruptcy Reports .... ☐

C.B.R. RBC (Revue de Barreau Canadien - CANADIAN BAR REVIEW .... ☐

Revue du Barreau .... ☐

Revue du Notariat .... ☐

S.R.Q./R.S.Q. (Statuts refondus du Québec 1964 ....
REVISED STATUTES OF QUEBEC 1964 ..... ☐

S.R.C./R.S.C. (Statuts revisés du Canada 1952 .....
REVISED STATUTES OF CANADA 1952 ..... ☐

Gagnon Index Gagnon .... ☐

Annuaire de jurisprudence du Québec ....
(Beauchamp, St-Cyr, Levesque) ☐

The Canada Statute Citator .... ☐

The Canadian Abridgment .... ☐

Gazette Officielle du Québec ....
Quebec Official Gazette ☐

Gazette du Canada, partie I ....
Canada Gazette, Part I .... ☐

Gazette du Canada, partie II ....
Canada Gazette, Part II ☐

....

20. Dans une réponse fournie par un système de recherche automatisé <u>en jurisprudence</u>, quels sont les éléments d'information que vous croyez indispensables?
IN ANY REPLY FURNISHED BY AN AUTOMATED LEGAL RESEARCH SYSTEM IN <u>JURISPRUDENCE</u>, WHICH OF THE FOLLOWING DETAILS WOULD YOU CONSIDER INDISPENSABLE?

(1) Oui YES

(2) Non NO

la référence exacte (ex. 1966 BR 343)
THE EXACT REFERENCE (EG. 1966 QB 343) ☐

le nom des parties
THE NAMES OF THE PARTIES ☐

le résumé en mots clés publié dans les rapports judiciaires
THE KEY-WORDS FRAMEWORK AS PUBLISHED IN THE JUDICIAL REPORTS ☐

le nom des juges, la date de l'arrêt
THE NAMES OF THE JUDGES AND DATE OF JUDGMENT ☐

le nom des avocats qui ont plaidé la cause
THE NAMES OF THE ATTORNEYS WHO PLEADED THE CASE ☐

jugement par défaut, ex-parte ou après contestation
INDICATION IF JUDGMENT RENDERED IN DEFAULT' EX-PARTE CONTESTED ACTION ☐

la page et le paragraphe où se trouve l'information demandée
THE PAGE AND PARAGRAPH WHERE THE REQUESTED INFORMATION IS FOUND ☐

l'arrêté ou jugé de l'arrêt publié dans les rapports judiciaires
THE SUMMARY OR "JUGE" OF THE CASE AS PUBLISHED IN THE JUDICIAL REPORTS ☐

21. Dans une réponse fournie par un système de recherche automatisé <u>en législation</u>, quels sont les éléments d'information que vous croyez indispensables?
IN ANY REPLY FURNISHED BY AN AUTOMATED LEGAL RESEARCH SYSTEM <u>IN LEGISLATION</u>, WHICH OF THE FOLLOWING DETAILS WOULD YOU CONSIDER INDISPENSABLE?

(1) Oui YES
(2) Non NO

La référence au chapître, à l'article et au paragraphe de la loi THE REFERENCE TO THE CHAPTER, ARTICLE AND PARAGRAPH OF THE ACT	☐
Le titre officiel de la loi THE OFFICIAL TITLE OF THE ACT	☐
Le texte intégral de la loi THE FULL TEXT OF THE ACT	☐
Le texte de la loi revisée en tenant compte des derniers amendements THE TEXT OF THE ACT AS REVISED TO DATE	☐
Les références aux arrêtés en Conseil THE REFERENCES TO ORDERS IN COUNCIL.	☐
Le texte des arrêtés en Conseil THE FULL TEXT OF THE ORDERS IN COUNCIL	☐

....

22. Etes-vous intéressé à connaître systématiquement l'existence des projets de loi déposés devant la législature dès leur première lecture?
ARE YOU INTERESTED IN FOLLOWING SYSTEMATICALLY THE BILLS INTRODUCED IN THE LEGISLATURE STARTING FROM FIRST READING?

(1) Oui YES
(2) Non NO

RESOURCES QUESTIONNAIRE

DISTRIBUTION LIST &

LIST OF RESPONDENTS

Present

1.0 What kind of data bank do you use to-day?

1.1 How are the present systems being used?

1.2 Are they used as conceived?

1.3 How is the data obtained and updated?

1.4 How much effort is required to obtain and update the data? Manhours, dollars, etc.

1.5 Are the systems economical?

1.6 What kind of support is necessary to establish and maintain such data banks? For example, facility, community, industrial, or government, and internal support such as programmers, machine supplies, students, etc.

1.7 How are users charged for data bank services?

Future

2.0 What system (regardless of communication means) concepts are you currently pursuing?

2.1 Are these concepts being co-ordinated on a larger scale with other organizations?

2.2 What kind of data bank systems do you believe are needed within the coming decade? Why? Examples might be computerized data banks, audio retrieval systems, video retrieval systems, etc.

RESOURCES QUESTIONNAIRE

Future

2.3 Do you envisage regional, national, or international access to such data banks? How?

2.4 Do large data bank networks necessarily mean special types of retrieval services? What form of output do you need?

2.5 Who should have access to such data bank systems?

2.6 Which services do you feel should be free? Which ones for a fee?

2.7 What is your opinion of the economics of such systems? What support (financial, personnel) do you consider necessary to establish and maintain them?

2.8 How would you go about developing and establishing data bank systems on a national scale?

2.9 Would you identify technological, institutional, legal, political and other factors which you feel may influence the implementation of these needed systems? Is legal certification a problem?

3.0 Who should decide what information should be placed on these systems?

3.1 Are you concerned about privacy of information? Copyright? Security? How would you like to see these issues handled?

3.2 Will these data bank systems promote national interests?

3.3 To what extent will the existence of national data banks, such as, Canadian statistics, meteorology, agronomy, pollution, water resources, patents, etc., be of direct benefit to your organization, or affect your long term plans for educational data banks?

Future

3.4 Do you think large scale data banks will contribute significantly in producing better informed Canadians? If not, do you see any alternatives?

Note: Additional views and recommendations are welcome.

LIST OF RESPONDENTS TO QUESTIONNAIRE

- Arctic Institute of North America
  3458 Redpath
  Montreal, Quebec

  Miss N.T. Corley
  Librarian

- Canadian Aeronautics and Space Institute
  77 Metcalfe Street, Room 416
  Ottawa 4, Ontario

  Mr. H.C. Luttman
  Secretary

- Canadian Council of Resources Ministers
  620 Dorchester Blvd. W., 8th Floor
  Montreal 2, Quebec

  Mr. C. deLaet
  Secretary

- Canadian Printing Ink Manufacturers' Association
  67 Yonge Street
  Toronto, Ontario

  Mr. W.M. Griffith

- Canadian Teachers' Federation
  320 Queen Street
  Ottawa, Ontario

  Dr. G. Richert
  Executive Assistant

- City of Ottawa Public School Board
  330 Gilmour Street
  Ottawa, Ontario

  Mr. A.P. Hanwell
  Superintendent

- Dalhousie University
  Halifax, Nova Scotia

  L. Vagianos
  Professor & Director of University Libraries

  Miss Susan Whitside
  Librarian

- Energy, Mines & Resources
  Ottawa, Ontario

  Dr. A.K. Biswas
  Resource Management Studies Section

  Dr. C.F. Burk
  National Coordinator
  Geological Survey of Canada

  Mr. J.A. Gilliland
  Hydrologic Sciences Division

  Mr. A. Kuhn
  Head, Resource Data Section

  Mr. B.A. McGee
  Index Supervisor
  Geological Survey of Canada

  Dr. L.W. Morley
  Director, Program Planning Office

  Mr. A.W. Muir
  Fiancial and Management Advisor

  Mr. W.J. Ozga
  Head of Data Control Section

  Mr. A.E. Peterson
  Head, Special Studies

  Mr. P.J. Reynolds
  Chief, Resource Research Centre

- Falconbridge Nickel Mines Ltd.
  7 King Street, E
  Toronto, Ontario

  Mr. S. Collett
  Information Supervisor

- Forest Ranger School
  Fredericton, New Brunswick

  Mr. E.T. Owens

- Garde-Hansen, Mr. H.
  3049 Linden Drive SW
  Calgary, Alberta

- Machinery and Equipment Manufacturers Association of Canada
  116 Albert Street
  Ottawa, Ontario

  Mr. C.A. Peck

- Manitoba Government
  Department of Mines and Natural Resources
  310 Legislative Building
  Winnipeg, Manitoba

  Dr. K.A. Phillips
  Chief Geologist

- National Research Council
  Ottawa, Ontario

  Mr. L.G. Coté
  Chief, National Research Council
  Computation Centre

  Mr. S.G. Jones
  Radio and Electrical Engineering Division

- National Science Library
  Ottawa, Ontario

  Dr. J.E. Brown
  Chief Librarian

- New Brunswick Research and Productivity Council
  College Hill Road
  Fredericton, New Brunswick

  Dr. C. Bursill
  Executive Director

- Nova Scotia Government
  Nova Scotia Research Foundation
  5182 Prine Street, P.O. Box 1027
  Halifax, Nova Scotia

  Dr. J.E. Blanchard
  Vice-President

- Ontario Government Department of Lands & Forests
  Queen's Park
  Toronto, Ontario

  Mr. G.H. Bayly
  Deputy Minister

- Ontario Research Foundation
  Sheridan Park, Clarkson, Ontario

  Dr. W.M. Campbell
  Director of Research

  Mr. C.R. Holmes
  Supervisor, Information Services

- Public Service Commission of Canada
  Ottawa, Ontario

  Mr. H. Woods
  Manager, Planning Information Management Centre

- Pulp and Paper Research Institute of Canada
  570 St. Johns Road
  Pointe Claire, Quebec

  Mr. K.E. Vroom
  Secretary

- Regional Economic Expansion
  Ottawa, Ontario

  Mr. J.J. Foster
  Director of Information Systems

- Symbionics Systems Ltd.
  544 - 550 Berry Street
  Winnipeg 21, Manitoba

  Dr. B.A. Hodson
  President

- University of Alberta
  Education Building
  89 Ave. & 114 Street
  Edmonton, Alberta

  Dr. S.M. Hunka
  Educational Research

- University of Calgary
  Calgary, Alberta

  Mr. F.T. Dolan
  Data Center

- University of British Columbia
  Vancouver 8, British Columbia

  Professor James M. Kennedy
  Computer Science Department

  Professor J.H.G. Smith
  Canadian Institute of Forestry

- University of Guelph
  Guelph, Ontario

  Mr. L.F. MacRae
  Chief Librarian

- University of Manitoba
  Winnipeg 19, Manitoba

  Dr. D.A. Young
  Associate Professor
  Department of Computer Science

- University of Toronto
  167 College Street
  Toronto, Ontario

  Mr. W.J. Kurmey
  Associate Professor
  School of Library Science

- Watts Griffis & McOuat Ltd.
  159 Bay Street
  Toronto, Ontario

  Mr. R.B. Lawrence

TABLE OF CONTENTS
FOR
SIX SUB-GROUP REPORTS

APPENDICES Page

B - Urban Affairs Data Banks

Table of Contents

Appendix F Some Selected Methods and Techniques Applicable to Urban and Regional Information Use

Appendix G Summary Report of a Regional Co-operative Computer Plan

C - Consumer Data Banks

Part I

1. Introduction
2. The Communications and Information Needs of the General Public
3. The Significance of the New Technology and Some Questions about Its Development in Canada

Part II

1. Introduction
2. The Case of Large Scale Data Banks for the General Public
3. A Community Information Network
    a. The growth of an idea.
    b. The idea of a community information network.
    c. What is meant by a community information network?
    d. Who would use it?
    e. How would it be used?
    f. How much use would it get?
    g. What characteristics should it have?
    h. How could such characteristics be achieved?
    i. What would it cost?
    j. How would it be financed?
    k. How would it be related to other systems?
    l. What institutional factors would affect its development?
    m. How would its development affect existing institutions?
    n. What would be the role of government?

o. What steps need be taken to create a network?

   i. A clearinghouse

   ii. A research design

p. The role of the Government of Canada and the Department of Communications.

4. Summary and Conclusions

Appendix A: Some Existing Public Information Systems in Canada

Appendix B: Some potential Data Files and Data Banks

Appendix C: A Preliminary Research Design

D - Resources Data Banks

E - Industrial Data Banks

APPENDICES

F - Medical Data Banks

SOME EXISTING CANADIAN DATA BANKS

Information Service	Information Class: Science/Technical Prim.	Science/Technical Sec.	Science/Technical Tert.	Quantitative Prim.	Quantitative Sec.	Quantitative Tert.	Qualitative Prim.	Qualitative Sec.	Qualitative Tert.
(a) Mission-Oriented Data Banks:									
BEAM (Construction Industry)	V		X	V		X	V		X
(b) Subject-Oriented Data Banks:									
CANSIM				X					
FRI				X					
FTS				X					
Labour Agreements				V	X				
Cdn. Geosci. Index			X						
CAN/ADI	V	X	X						
TIS	V	V	X						
SOCRATES	V	X	X						
AIRA		X	X						
QUICLAW							X		
PROJECT DATUM								X	

Notes:

1) Primary Information - the original form of the information as the original article, book, or group of statistics.

2) Secondary Information - the abstracts, summaries, excerpts or highlights of the original information.

3) Tertiary Information - reference indexes to either secondary or primary information.

X - Within computer-based system.

V - Auxiliary to the computer-based system.

- Taken from Industrial Sector Report -

NEWS RELEASE ON

NATIONAL RESEARCH COUNCIL ADVISORY BOARD

ON SCIENTIFIC AND TECHNOLOGICAL INFORMATION

The National Research Council of Canada today announced the appointment of a 20-member Advisory Board on Scientific and Technological Information to formulate broad policy guidelines for the continuing development of a national Scientific and Technological Information (STI) system in Canada.

The announcement follows a January decision of the Federal Government to designate NRC to develop, under the general direction of the National Librarian and in cooperation with existing informational organizations, an STI system encompassing the natural sciences and engineering. The January decision was based on recommendations made in the fall of 1969 by the Science Council of Canada.

Dr. W.G. Schneider, President of NRC, announced that Dr. G.W. Holbrook, President, Nova Scotia Technical College, Halifax, has been appointed Chairman of the Board. The Vice-Chairman is Dr. Lionel Boulet, Directeur, Institut de Recherches de l'Hydro-Québec, Varennes, Québec. The Board will advise NRC on the activities and priorities necessary to undertake, assist or promote the dissemination of scientific and technological information in Canada.

Expenditures for this purpose will be recommended by the Board under a separate Parliamentary vote. Among other things, funds will be earmarked for grants in aid of research, scholarships to promote the training of information specialists and contracts to further a national STI System.

The Board will make recommendations with respect to the activities of Council committees dealing directly with scientific and technological information, participation in the activities of international organizations in the field of STI, and arrangements for international collaboration. It will also recommend methods for the best use of existing STI resources in Canada and for the development of existing and, where necessary, new scientific and technological publications and other means of disseminating information.

The Board will have power to create certain committees of its own to assist in its work. Membership on these committees will not necessarily be restricted to Board members. The participation of the libraries of Federal government departments and

agencies which have extensive holdings in science and technology will be coordinated by the National Librarian, and it is expected that a committee will be created with representation from departments and agencies to facilitate their participation.

Expansion of Canadian STI dissemination services is necessary in order to cope with the current "information explosion". It will be the role of NRC to see that all areas of science receive adequate coverage and to see that the STI system is integrated as fully as possible with information systems covering other fields of knowledge.

Other members of the Board are:

Mr. Raymond Beaudoin, Vice-président aux communications, Université de Québec, Québec City

Dr. John C. Beck, Physician-in-Chief, Royal Victoria Hospital, Montreal

Dr. Robert Blackburn, Chief Librarian, University of Toronto

Dr. J.E. Brown, National Science Librarian, National Research Council of Canada, Ottawa

Dr. D.A. Chisholm, Vice-President, Research & Development, Northern Electric Company Limited, Ottawa

Dr. L.A. Cox, Director of Research, MacMillan Bloedel Limited, Vancouver

M. Guy Forget, Directeur, Centre de documentation, Université Laval, Québec

Dr. Norman S. Grace, Dunlop Research Centre, Sheridan Park, Ontario

Dr. H.W. Habgood, Chief, Fuels Branch, Research Council of Alberta, Edmonton

Dr. Leon Katz, Director, Accelerator Laboratory, University of Saskatchewan, Saskatoon

Mr. L.F. MacRae, Associate National Librarian, National Library, Ottawa

Dr. J.A. Morrison, Director, Institute for Materials Research, McMaster University, Hamilton, Ontario

Dr. W.A. Riddell, Assistant to the President, University of Saskatchewan, Regina Campus, Regina

Dr. Pierre Robert, Directeur, Département d'informatique, Université de Montréal, Montréal

Dr. Samuel Rothstein, Director, School of Librarianship, University of British Columbia, Vancouver

Dr. J.G. Sylvestre, National Librarian, National Library, Ottawa

Dr. K.F. Tupper, Vice-President (Administration), National Research Council of Canada, Ottawa

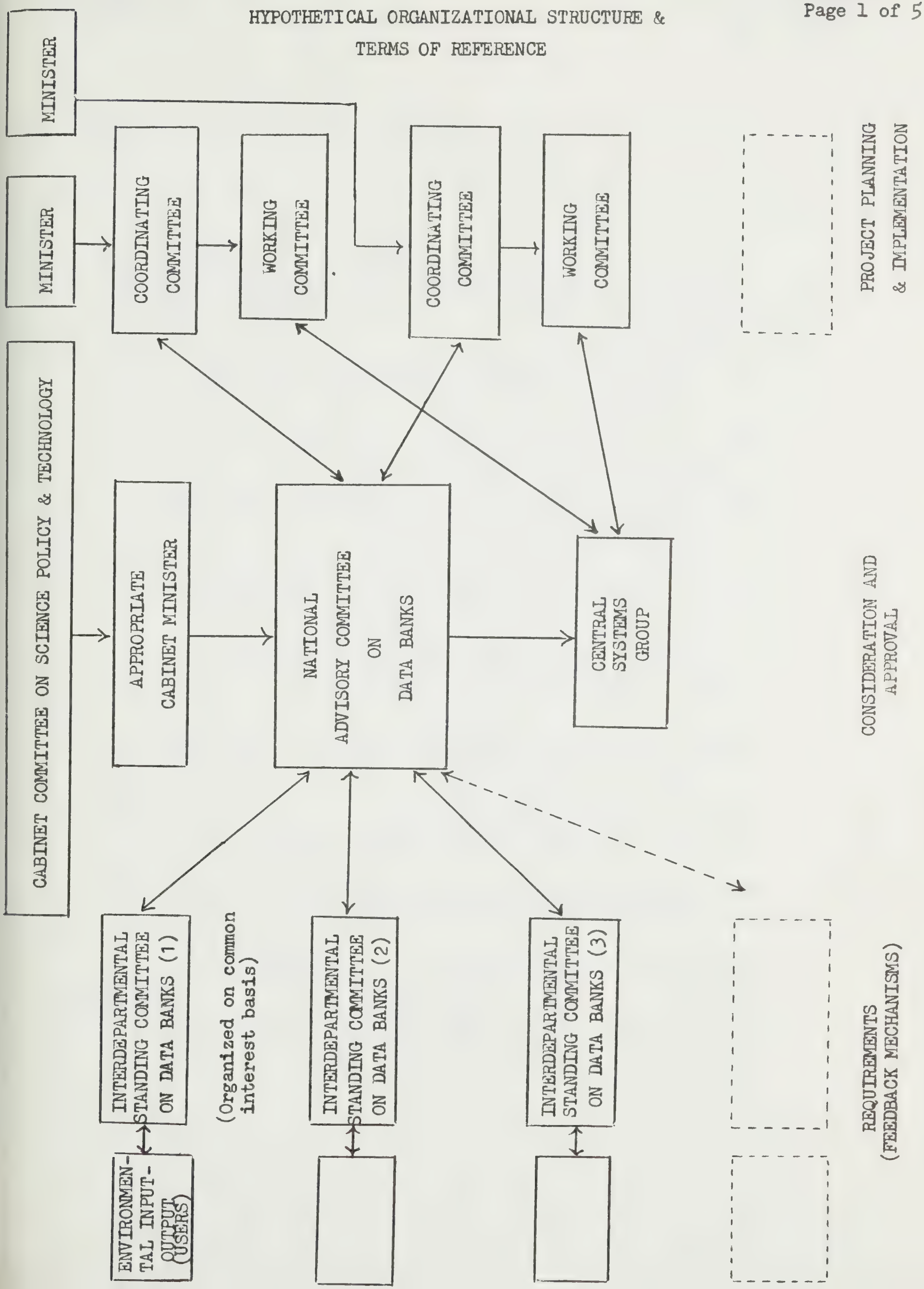
Dr. Louis Vagianos, Director of Communications, Computer Centre, Dalhousie University, Halifax

MATRIX SUMMARY OF INSTITUTIONAL ARRANGEMENTS

Type of Bank	Institutional Arrangements / Phase	Non Profit Groups	Inter Gov. Bodies	Agency Fed. Prov.	Gov. Int. Groups	Coord. Agencies	Inter Gov. Bodies & Special Groups
Resources	Planning			x			
	Implementation					x	
	Operation					x	
Legal	Planning			x			
	Implementation			x			
	Operation					x	
Medical	Planning		x				
	Implementation		x				
	Operation					x	
Urban	Planning						x
	Implementation						x
	Operation						x
Consumer	Planning	x					
	Implementation	x					
	Operation	x					
Industry	Planning				x		
	Implementation				x		
	Operation					x	

Legend: Int. - Interest
Coord. - Coordinating

HYPOTHETICAL ORGANIZATIONAL STRUCTURE &
TERMS OF REFERENCE



TERMS OF REFERENCE

National Advisory Committee

The National Advisory Committee on Data Banks shall assess the requirements for, and the problems associated with, data banks in promoting national and public well-being, and shall advise an appropriate Minister on:

(a) the adequacy of existing data banks in serving the national and public interest;

(b) the priorities which should be assigned to specific requirements for data banks;

(c) the effective development, operation and utilization of data banks;

(d) the best means of developing and maintaining cooperation between different organizations for the development of data banks;

(e) criteria for deciding on the choice among various government and non-government agencies to operate a 'national' data bank;

(f) the information necessary to provide a proper basis for the formulation of government policy in regard to data banks;

(g) the requirements for, and means of obtaining, standardization in data structure and programming;

(h) the appropriate cooperation with international and foreign agencies concerned with data banks;

(i) problems which may require special legislation.

In addition, this Committee shall advise the Coordinating Committee for a specific data bank on problems referred to it.

Central Systems Group

The Central Systems Group shall be responsible for:

A. Assisting the National Advisory Committee on the Data Banks by providing them with technical information, and by alerting them to existing and potential problems related to data banks; and

B. Providing assistance in the conceptual, design and implementation phases of the development of specific data banks

In particular they will:-

(a) make recommendations to the National Advisory Committee (N.A.C.) on standards associated with data bank development and operation, for ensuring compatibility of data structure in related data banks, and for achieving as great a degree of machine independence as possible;

(b) appraise the N.A.C. of problems requiring its attention;

(c) provide technical information and advice on technical matters to the N.A.C. when requested;

(d) evaluate general data base management systems available on the market;

(e) develop general utility programs for data management;

(f) keep abreast of software and hardware developments (including telecommunications) related to the efficient and effective operation of data banks;

(g) when requested, take responsibility for specified aspects of the development and implementation of a particular data bank.

The permanent staff in the Group should be augmented by a small number of 'experts' appointed on contract, or by special arrangement, for periods up to two years.

The Coordinating Committee (of a specific data bank)

The Coordinating Committee for a specific data bank shall facilitate the development of the data bank by:

(a) resolving problems of a "strategic" nature, such as those related to possible conflicts of interest

(b) referring such problems to the National Advisory Committee for guidance if deemed desirable

(c) making representations to the appropriate quarters for funds to cover development

(d) allocating funds to the various activities

(e) establishing specific terms of reference, and general guidelines for the Working Committee

(f) monitoring progress of the Working Committee

(g) assessing the final recommendations of the Working Committee to ensure that all user requirements have been listed in the specifications

(h) recommending to the appropriate authority* the procedures to be adopted in the design and implementation phases.

* In many cases this will be the Minister (or his deputy) of the particular Federal Government department primarily responsible for the subject matter of the data bank. In some cases the recommendations will be forwarded to the National Advisory Committee for consideration and forwarding to the Minister responsible for the NAC.

The Working Committee (of a specific data bank)

Specific terms of reference and general guidelines will be drawn up in each individual case by the Coordinating Committee for that data bank. In general the functions of the Working Committee will include the following:

(a) definition of input and output requirements

(b) assessment of standards, and necessity for compatibility with related data banks

(c) assessment of requirements for staff, money and other resources in the design phase, and projection of such requirements in the implementation and operation phases

(d) definition of responsibilities of the various cooperating organizations in the development and operation of the data bank

(e) assessment of security requirements

(f) preparation of an implementation schedule, together with recommendations for monitoring progress

(g) recommendations for monitoring operations to ensure effective and equitable service

(h) assessment of growth requirements

TELECOMMISSION

Study 5(g)

Problems in Data Transfer with Particular Regard to Visual Data

The Department of Communications

STUDY 5 (g)

PROBLEMS IN DATA TRANSFER WITH PARTICULAR REGARD TO VISUAL DATA

Available by mail from Information Canada, Ottawa,
and at the following Information Canada bookshops:

HALIFAX
1735 Barrington Street

MONTREAL
1182 St. Catherine Street West

OTTAWA
171 Slater Street

TORONTO
221 Yonge Street

WINNIPEG
393 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

Price: $1.25 Catalogue No. Co41-1/5G

Price subject to change without notice

Information Canada
Ottawa, 1971

This Report was prepared for the Department of Communications by a project team made up of representatives from various organizations and does not necessarily represent the views of the Department or of the federal Government, and no commitment for future action should be inferred from the recommendations of the participants.

This Report is to be considered as a background working paper and no effort has been made to edit it for uniformity of terminology with other studies.

PROJECT TEAM

Kar Liang - Liaison Officer,
National Film Board

J. N. Bloom,
Communications Research Centre,
Department of Communications

V. C. P. Strahlendrof, M. Westelman,
Trans Canada Telephone Systems

R. G. Dreyer,
Vice President,
TMC (Canada) Ltd.

Prof. Leslie Mezei,
Department of Computer Sciences,
University of Toronto

TABLE OF CONTENTS

Terms of Reference

Visual information is becoming increasingly important in the spectrum of communications. Technical developments of recent years (film equipment, television, videotape, computer-controlled display terminals, microfilm systems, etc.) have made the transfer of such information possible on a larger scale and the transmission of such information over voice-grade and wideband telecommunication channels desirable. The complexity and volume of data that institutions in our society have to deal with today makes the use of graphic techniques of data presentation imperative, as one picture can be more valuable and easily understood than pages of lineprinter output.

This study should outline not only current situations, but focus also on future potentials and problems and recommend policies to encourage the utilization of these potentials as well as methods to overcome the problems.

Among other developments the recent capabilities of computers in the visual area have far-reaching implications. There are three major media for displaying moving images: motion picture film, television and videotape, and computer-controlled display. Though these have different technical requirements their uses should be considered together. In fact, the computer can serve as the integrating link, since scanning and recording of documents, graphics and film are now possible by computer, and the same is true of videotape.

The programmed versatility of the computer in future graphic systems will add a new dimension. In addition to conventional pictures, such systems will be capable of dynamic data display to help us visualize our information with regard to its development in time. Thus, we will be able to view on a map, for example, changes in population, income, transportation, pollution counts, housing, data communication, etc. in the form of continuously changing images.

Such computer-generated moving images can also be simulated to depict situations and environments which are abstract or only conceptual, and provide new insights into urban planning, architecture, animated film and television productions, etc. The images can further be stored in a central memory from which they can be processed, retrieved, manipulated and viewed remotely. Should reproduction be required, they can be electronically typeset for printing and recorded on film and videotape.

The study should be broader, however, and should consider the needs and applications of the current users of visual data communication, as well as projects on computer graphics which are now being developed in universities, government and industry.

1. Describe the status quo with regard to the generation, transformation and transmission of different forms of a visual information. To that end:

   (a) Outline the various methods now in use for the generation, transformation and transmission of visual information;

   (b) Outline the various applications of these methods;

   (c) Outline the various capabilities of present methods of generating, transforming and transmitting visual information;

   (d) Outline the problems arising from the status quo.

2. What are the present requirements imposed on our telecommunication facilities for the transfer of data to support the current needs in visual communications?

3. What are the future requirements imposed on our telecommunication facilities for the transfer of data to support the expected and potential needs in visual communications?

4. What new services may emerge in the next decade?

5. What are the potential social effects of an increasing demand for and utilization of visual information communications systems?

A Graphical Overview

<u>Conventional</u>

Displayed visual information is one-way, content is same for all viewers and cannot be altered.

1. Television
2. Films
3. Printed Materials

<u>New</u>

Displayed visual information, depends on the individual's instructions and can be manipulated by the user via the computer.

Visual Data Display

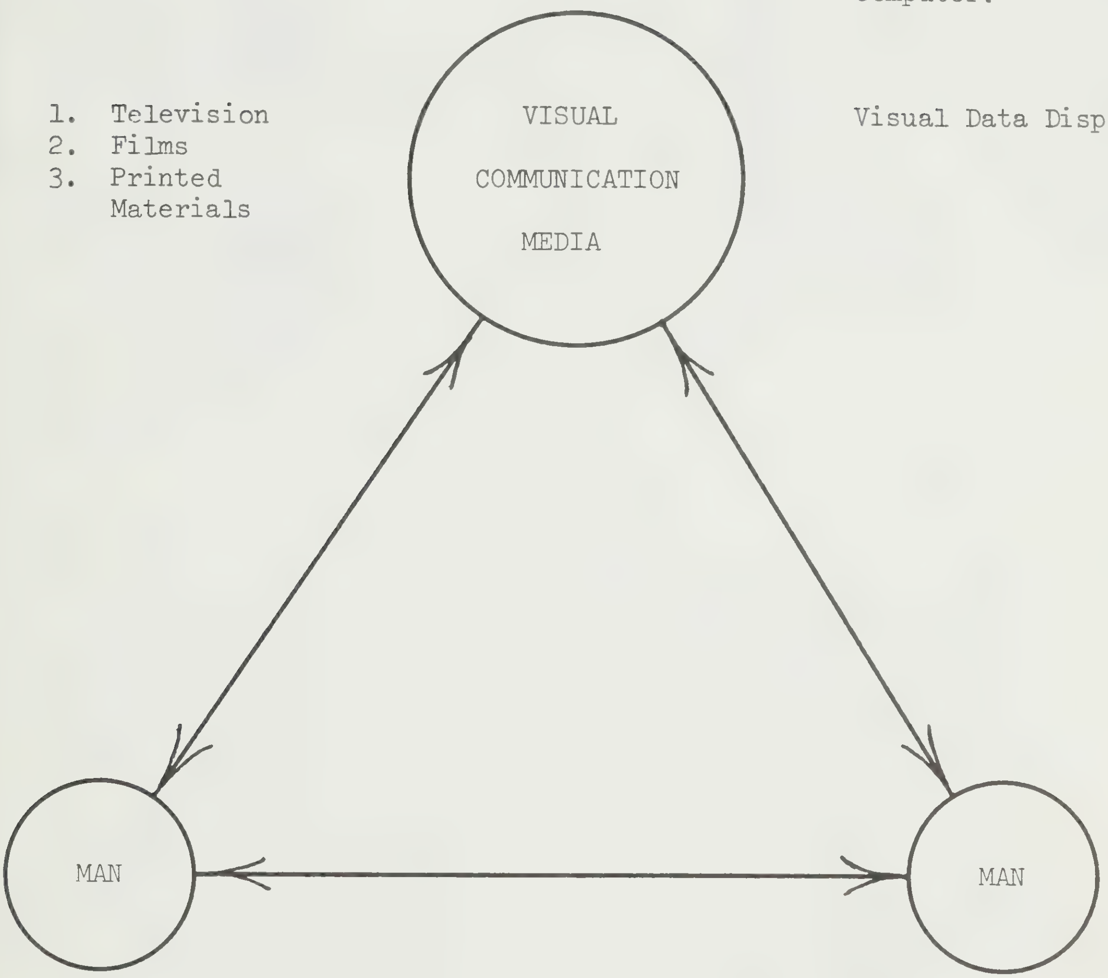


Figure 1. The Enhancement of Man to Man Communication through Visual Media

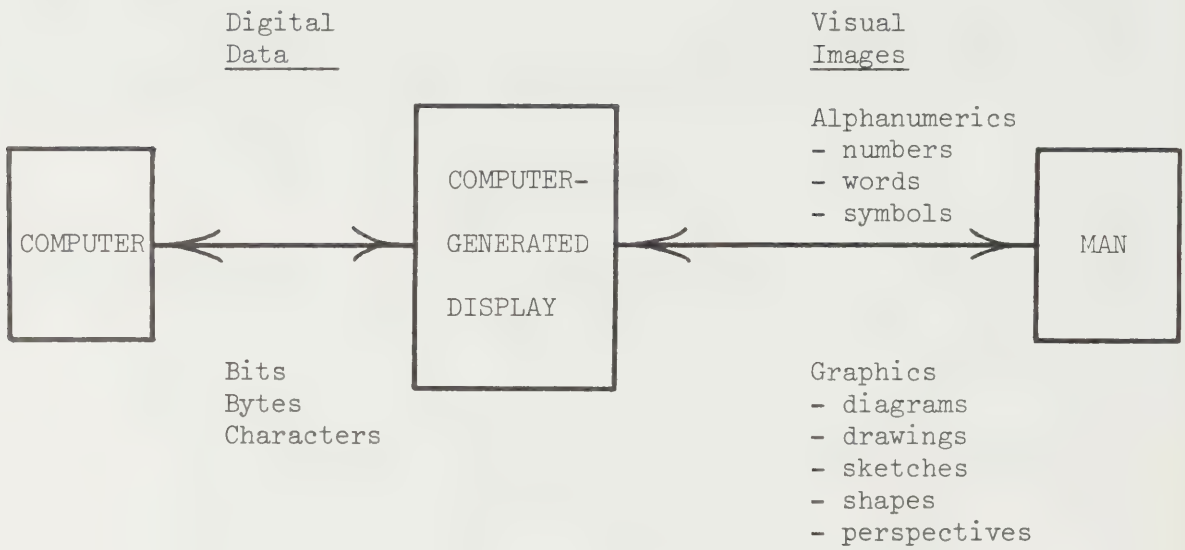


Figure 2. The Enhancement of Computer to Man and Man to Computer Communications through Visual Display

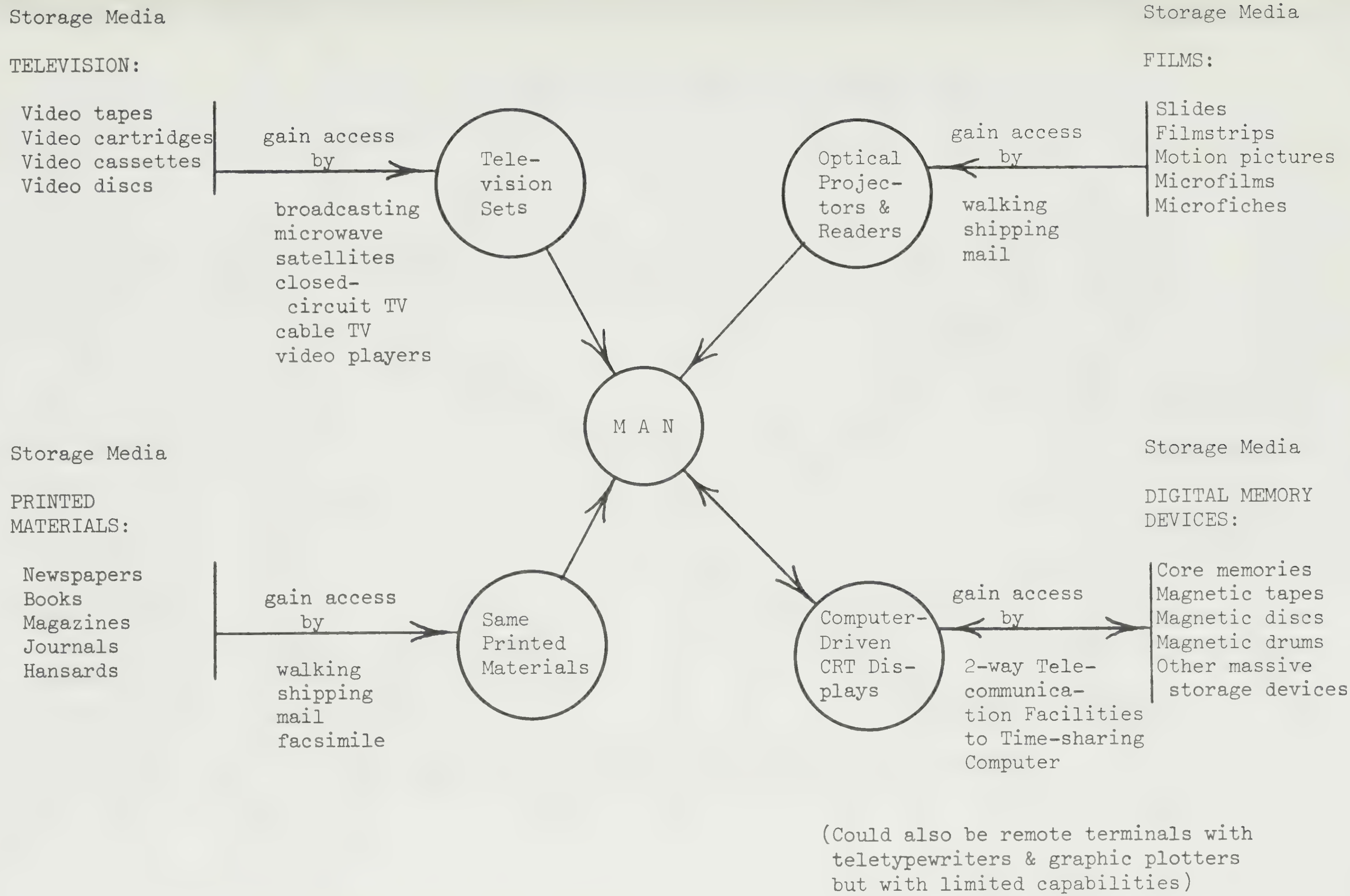


Figure 3. Different Forms of Visual Information Transfer

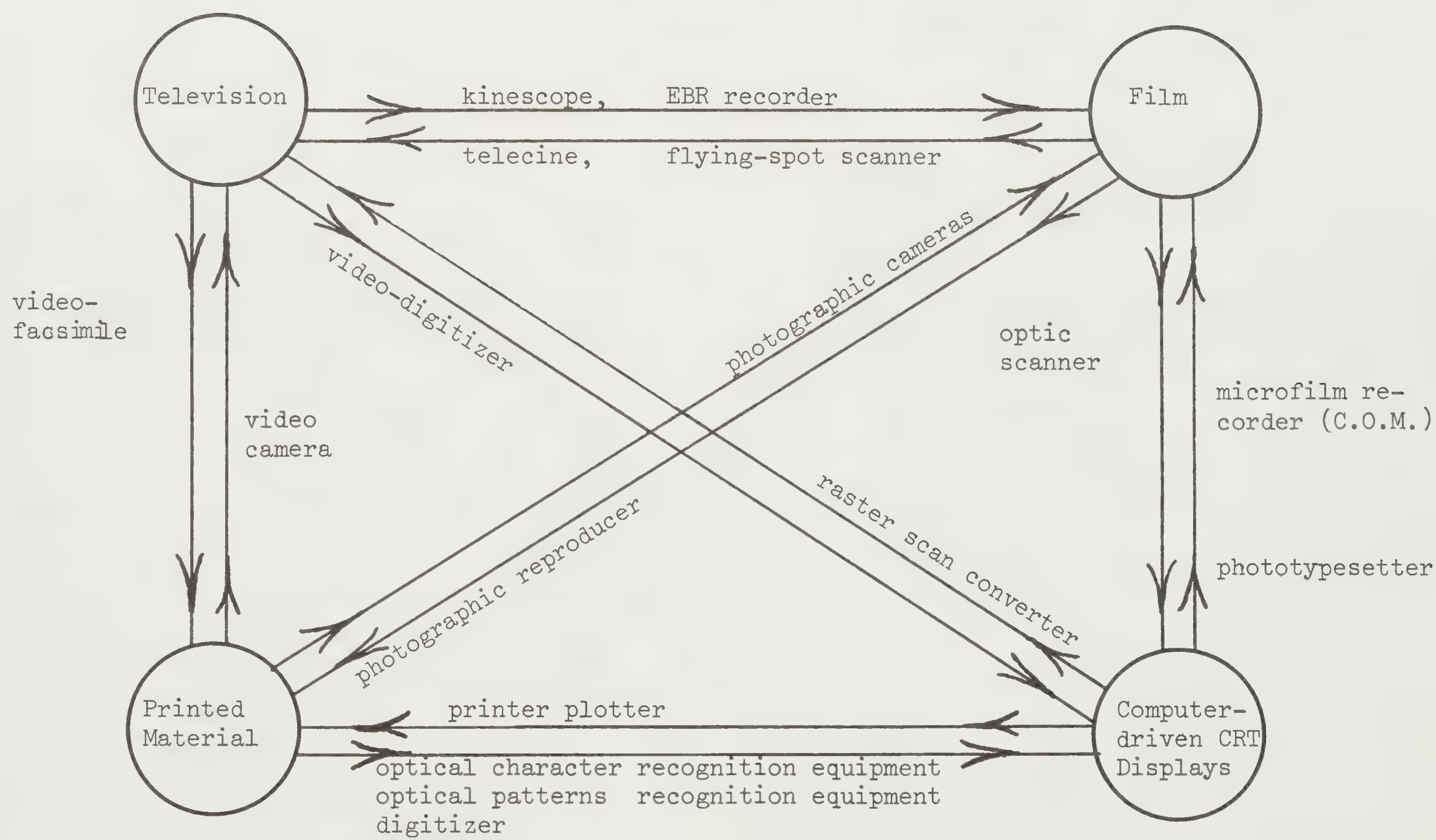


Figure 4. Different Transfer and Conversion Processes for the Interchangeability of Visual Media

Status Quo of Visual Information
Relating to:
1. Visual Data Display

A visual data display is a new form of visual medium and it can be defined as any device which converts computer output data into alphanumerics and graphics. Such visual display devices cover a tremendous variety, from the simple electro-magnetic numeric indicators to holographic display systems. In between, there are many others, such as electric typewriters, high-speed electrostatic line printers, large display boards employing hundreds of electro-magnetic discs for flight information and stock market quotations, and the $16\frac{1}{2}'$ x $42'$ light board used for message displays at EXPO '67.

However, it is the continuous development of radar and television that has provided the cathode-ray-tube (CRT) as the most promising computer output display for use today and, most likely, for the next decade. The CRT, with its associated electronic display control, permits the "drawing" of visual data on the face of the tube at electronic speed. Thus, it can be used as a very efficient man-computer interface, and is particularly suitable for many on-line applications, such as the monitoring of industrial processes, airline reservations, stock quotations, etc. The study leans more heavily toward CRT developments, not only because of its capabilities and versatilities as a display device but also its use as an imaging device in the microfilm recorder and phototypesetter.

Much of the CRT display technology is derived mainly from applications developed for early military command control systems, such as in the SAGE (semi-automatic ground environment) air defence computer system and, recently, for the Mission Control System at the NASA Manned Spacecraft Center. In these systems, operational personnel must monitor over the face of the CRT displays all real-time data in easily readable visual forms, such as pictures, diagrams, symbols, numbers, and words; as well as be able to interact and instruct the computer by pushing function keys and by simply pointing, with a light pen at the appropriate information on the display. Though developed at tremendous cost, such computer-driven CRT display systems have demonstrated their value and efficiency as tools for man-computer communications. The capability for immediate showing of results in visual and easily readable forms reduces the time and improves the soundness of decisions.

During the past few years, the computer-driven CRT visual data display systems have found increasing numbers of scientific, technical, educational and commercial usages. Today, such visual data display devices are used in a variety of areas representing multiplicity of disciplines, such as in management information, process control, air traffic control, simulation,

computer-aided design, computer-aided instruction, information retrieval, pattern recognition, graphic arts, printing, publishing, computer-produced motion pictures, TV, etc.

Type of Display

Depending on applications, three types of displays are in general use: alphanumeric, graphics, and large screen. They differ in size as well as in functions.

"Alphanumeric displays" generally come as tabletop size, with small CRT display screen, and are ideal for the single user. They are used to monitor computer-processed output, as 'soft copy' display, are noiseless in operation with limited keyboard facilities in communicating with the computer. Such alphanumeric type displays are gradually replacing the much used teletypewriters as a remote terminal in time-sharing computer systems, as evidenced in airline reservation and management information systems.

"Graphic displays" generally are housed in a console with a much larger CRT screen and can be viewed only by a few people at the same time. Such displays are capable of presenting both graphic and alphanumeric data. They are used mostly as a stand-alone system but are now slowly developing as a remote graphic system, on-line to time-sharing computers. Usually, very flexible facilities are included: keyboard, function keys, light pen, track ball, joy stick and line-drawing device (data tablet). This enables the user to interact very effectively with the displayed visual data.

"Large screen displays" are designed for group viewing. They are used mostly in military command and control systems and at NASA where graphic and alphanumeric data is optically projected onto a large rear-projection screen. Although the large screen display has similar capabilities as the graphic system mentioned earlier, it is used mostly for visual monitoring purposes. Only very recently, a limited number of such large screen displays has been made available for non-government users.

Display Generation

Three types of visual data are generated for display purposes: point plotting, line or vector plotting, and alphanumeric characters. The display can generally be considered as a peripheral connected to a central computer through an electronic display controller. Information processed and digitally encoded by the computer, or stored on magnetic tape, is transferred to the display through the controller. The information can be visual data representing the numerical results from computer computations, or can be encoded information transferred from a data set in time-sharing computer system. It can also be information transferred locally, via keyboard, tape and light pen. The information

is then decoded and converted to analog voltages to direct a beam of electrons to write the visual information onto the CRT screen for display.

The commonly used methods to form visual information on the CRT screen are: random-beam positioning and raster scanning. In random-beam positioning, the screen is usually divided into 1024 x 1024 points to form a matrix. The electron beam is directed toward a specified position, and a blanking function turns on the beam when that position is reached. The random positioning method offers high precision, good resolution and tremendous flexibility, but is costly to build.

The raster scan method uses the familiar television scan scheme in which a fixed raster of evenly spaced horizontal lines is drawn across the entire screen. Visual information is displayed with a sequence of unblanking horizontal lines. Such raster scan-type display is much less expensive to build. Visually, the image quality is much lower than the random-beam positioning type but a rather inexpensive television monitor can be used as the display.

For alphanumeric data to be displayed, a character generator can be used to convert digitally coded signals into analog voltages for controlling the deflection of the CRT to form a prescribed alphanumeric character. The entire set of characters can also be stored as an etched stencil, which is mounted within the CRT. The electron beam can then be directed through the stencil for displaying the chosen characters on the screen. Another method of character generation uses a programmed dot matrix with a fixed number of dots to form each character. The character is displayed on the CRT screen by blanking all but those dots needed to form the specific character. Another method of character generation is to produce a number of strokes with specific orientations and magnitudes in forming the desired characters. However, the general rule is that visual quality and legibility of the alphanumeric data display is proportional to the cost.

For the line and vector type of data to be displayed in creating graphics and pictures, a considerable amount of data and graphic software storage is required. To reduce such storage and to speed up the graphic plotting, a vector generator can be used to link two defined end points with a series of closely-spaced dots or a solid line. Similarly, a complete circle can be drawn automatically by an electron beam with a circle generator by simply specifying the position of the center and the radius of the desired circle.

Methods and problems on display refreshing and manipulation will be discussed under "Computer Graphics" -- "Output Devices".

Remote Display

Visual data display devices are used increasingly as remote terminals to the time-sharing computer system. Through telecommunication facilities, geographically separated man and computer are linked together. The type of visual terminals varies from the simplest, with primitive CRT display and keyboard, to that of the sophisticated stand-alone computer-driven display with a complement of interactive devices. At present, most of the remote display systems for use in a time-sharing environment are designed to interface with telephone lines through data set or acoustic coupler.

Hardware, software, and communications needed for remote display are still costly. At the same time there is also a speed-cost mismatch problem involved. On one hand input data entry from keyboard is limited by typing speed of user. Consideringan average typing speed of 50 words per minute, that is still well below the data transmission speed of the voice grade telephone lines. On the other hand, most display terminals demand much higher data transfer rate from computer in order to make efficient hardware utilization. A combination of low speed and high speed data transfer rates between time-sharing computer and visual display terminals are desirable but such asymmetric line is not yet available.

However, depending on the way a particular display terminal is intended to be used, not all users require high speed display. Schemes have also been developed to reduce data transfer from the computer so as to be more compatible with data transmission rate of telephone link for three types of applications: monitoring, inquiring, and man-computer interaction.

In "monitoring", visual information is presented to the user and no feedback is required. Modified commercial television monitor can be used as visual display. Data transfers from the computer can then be converted to raster scan type video signals and be recorded and stored on video magnetic disc. With each track on the disc storing one picture for a display, a large number of television monitors can then share the same rotating disc memory for picture refreshing as well as storage. Data transfer will not be necessary, unless of course a change in visual information is required.

In "inquiring", some limited interactive capability is needed and a keyboard is usually provided. Specific inquiry is keyed in to the computer and a display with relevant but limited visual data is generated. Very simple CRT display with delay line for local picture refreshing is used, and the quality and the amount of visual data required for display is purposely set low. In addition, no graphical information is needed for this type of application. Therefore, the demand for transfer from the computer is much reduced.

In "man-computer interaction", where a display of characters, vectors, and curves are needed, generators capable of drawing these graphics can be employed. Since they are still costly, high speed digital circuits have been used in order to allow a number of local display terminals to time-share one single generator.

Much development work is still necessary to bring about a more favourable trade off between the remote display terminal cost and the amount of data to be transmitted over the telephone lines from the computer.

Multi-media display

There are many other traditional and conventional forms of visual data display techniques which can be used not only effectively as in present practice but can be integrated with computer-generated visual data as a multi-media form of display.

One method has been described earlier in which conventional television images and computer-generated visual data are electronically mixed and displayed over one or more of television monitors and receivers.

Slide and film projectors can be computer-controlled and the projected image optically mixed with computer-generated visual data display. Film is still a remarkable visual data storage medium, capable of retaining vast amounts of information in colour and well-defined detail. For many applications, information recorded on film or slides, such as maps, complex diagrams and elaborate scenes has been projected as static background material; while dynamic computer-generated visual data, requiring constant updating and interaction, has been displayed and optically combined onto a common viewing screen. The saving on memory storage requirements is very significant.

Such methods have been used mostly by military command and control systems, NASA, and air traffic control. They have also found some applications in computer-aided instruction and information and retrieval systems.

Future Display

Many new display devices are currently under active development in the U.S. and Canada, and there is continuing improvement in CRT-type displays, as well as those employing new techniques and new material. Flat panel displays, using glow-discharge scan and light intensification techniques, electro-luminescent matrix, plasma, liquid crystal, magneto-optics and others are already showing promise. With the advent of time-sharing computers, the remote visual data display terminal is becoming one of the fastest growth areas. The aim is to lower the cost of such terminals by providing both display and storage capabilities to the new devices, with added color features.

However, over the next few years at least, the raster scan-type TV-display will continue to be an attractive visual data display device. This is particularly desirable in that computer-generated visual data can be distributed through coaxial cables to a larger number of conventional TV monitors. In addition, with the use of scan conversion tube or conversion logics, the random beam-positioning type of display can be converted to a conventional raster scan-type TV display. If the scan converter is located near the central computer, coaxial cable can then be used for visual data transfer. It is thus apparent that with conventional video processing techniques, computer-generated visual data and television programs can be electronically mixed. The combined visual information in a variety of forms can reach a number of remote users through coaxial cable.

Status quo of Visual Information relating to:
2. Computer Graphics

"The graphic method, with its various developments, has been of immense service to almost every branch of science, and consequently many improvements have of late been effected. Laborious statistics have been replaced by diagrams in which the variations of a curve express in a most striking manner the several phases of a patiently observed phenomenon, and, further, a recording apparatus which works automatically can trace the curve of a physical or physiological event, which by reason of its slowness, its feebleness, or its rapidity, is otherwise not accessible to observation.

"Language is as slow and obscure a method of expressing the duration and sequence of events as the graphic method is lucid and easy to understand. As a matter of fact, it is the only natural mode of expressing such events; and, further, the information which this kind of record conveys is that which appeals to the eyes, usually the most reliable form in which it can be expressed."

From E. J. Marey, "Movement",
D. Appleton and Company,
New York, 1895.

"Vision, our creative response to the world, is basic, regardless of the area of our involvement with the world. It is central in shaping our physical, spatial environment, in grasping the new aspects of nature revealed by modern science, and, above all, in the experience of artists, who heighten our perception of the qualities of life and its joys and sorrows."

From Gyorgy Kepes, "Education of Vision",
Vision and Value Series,
Braziller, 1965.

"Computer Graphics" deals with the input, generation, storage, transformation and display of visual information, i.e., data in two or more space dimensions. It has often been said that true man-machine communication which is convenient for man will involve a large element of graphics. In addition to displaying the results of calculations and accepting procedure definitions graphically we also want computers to process pictorial material. Since the visual information must be coded for the computer numerically (coordinates of the points, etc.) it also becomes a candidate for remote transmission. The following categorizes the field into four logical sections according to the type of transformation involved:

Data to picture	e.g.	output of calculations, data display
Abstract to picture	e.g.	graphic simulation, picture generation
Picture to abstract	e.g.	picture analysis, pattern recognition
Picture to picture	e.g.	visual design, digital picture processing

Interactive and Passive

The two major modes of communication with the computer are "interactive graphics", corresponding to real-time conversational computing, and "passive graphics", corresponding to batch processing, where the result is not immediately seen. Although interaction offers great advantages, passive graphics also has a vast potential, and is generally simpler and cheaper.

Output Devices

A limited range of graphics can be achieved on a line printer or teletype, for example the SYMAP program for contour maps. Pen on paper "electromechanical plotters" are the most popular graphic output devices, ranging from inexpensive ($5,000) units to large, highly accurate drafting tables ($200,000). These may be operated remotely, with the plotting commands transmitted over a communications line. The "microfilm plotter" displays the information on a cathode ray tube which is automatically photographed, by a built-in asynchronous movie camera with the frame advance of the film being under program control. This results in an increase of speed of the order of one hundred, and results in a very condensed form for voluminous outputs.

The cathode ray tube itself is becoming widespread for alpha-numeric displays. Storage tubes with picture drawing capabilities are also inexpensive, on the order of a few thousand dollars. The interactive display systems use a fast decay phosphor so that the image can be altered rapidly, and the individual parts of the picture may be identified easily. This requires a "refresh" system (regenerating the picture about 40 times per second) using a buffer memory, or tying up the whole computer. In addition usually a "light-pen", "function keys", typewriter keyboard, etc. are also included.

Other devices for sketching and manipulating the pictures are available, such as "Rand tablets", "mice", "joy-sticks", etc. These systems start at around $100,000. There is a limit on the number of points or lines which may be displayed in one refresh cycle; exceeding this causes an unpleasant flicker. For real time motion to be displayed the picture has to be re-calculated rapidly; some systems are beginning to offer built-in hardware to speed up the basic functions, such as rotation scaling and translation of three dimensional objects. The soft-ware available is still crude, and the "data structures" needed (often organized as "linked lists" or "rings") tend to be too complex for efficient calculation.

The digitally-controlled machine tool may be con-sidered to be a three dimensional graphic output. Other devices may be controlled by digital (or analog) output from the computer. Such techniques will likely become popular in the multi-media environment type of art, for example, where the program can react to the environment perceived by various "sensors" (for temperature, pressure, smell, etc.) and control the action of several "effectors" (projectors, lights, sound synthesizers, etc.).

The latest developments are moving toward standard video output on standard TV sets, providing a cheap and readily available output device and making it possible to use color directly. The major problem is to transmit the large amount of information needed for video scan rapidly enough; this is being accomplished by means of drums or disc storage.

Input

The graphic information may be generated by program without any input, as is the case when we use the results of some calculations which are to be plotted, or the generation of basic geometric shapes where only the parameters need be supplied (e.g. the center and radius for a circle). For "line drawings" only the coordinates of the end points of the lines which make up the picture are required. These could be coded manually and entered on punched cards, or a semi-automatic "digitizer" may be used. These devices, costing about the same as plotters, generally include some type of stylus (like those on planimeters) which the operator guides over the curve. The coordinates of points along the curve are automatically recorded on punched cards, magnetic tape, or directly in a computer. Some automatic line followers are also available, useful only with simple line drawings, such as a plot of X vs Y or a seismograph tracing. The "flying spot scanners" (in the $250,000 range) scan a transparency such as microfilm in a TV type scan, recording the gray level at each spot. For 1,000 by 1,000 resolution 1,000,000 points are generated. The programmable scanners give over control of the scan to the program, so that with line following algorithms, for example, the amount of data recorded can be cut down drastically. This digital picture processing technology is still in an early stage of development.

Some of the devices for interactive input have already been mentioned. Other digital or analog inputs may also be arranged to control the procession. For example, in one system the motion of an "anthropomorphic" harness worn by a man can control the image on the scope, as can sound input such as music. It is in the area of input and output devices that we can look forward to the greatest changes in the next few years. Although these will bring great improvements, it is not yet clear whether they will also produce significant cost reductions.

Subfields of Computer Graphics

Computer graphics is one of the new fields of computer application. Various areas have been developing separately, with not much unification between them.

I. Plotter Graphics:

The relatively inexpensive equipment and the ease of programming for simple applications has made plotters quite popular in the scientific and engineering world. Plotting a function of Y against X is the obvious example. In Canada most plotters will be found in the West used mainly for plotting contour maps in geophysical exploration. Some projects for mapping city streets, etc. have also begun. The glamour of interactive graphics has retarded the acceptance of plotters more generally. Many people are aware only of the interactive graphics and when they find this too expensive and complex for their applications usually abandon further consideration of it. However, beginning with passive graphics is a good way to obtain experience in this field, and much useful work can be done with it, such as sales charts, market studies, etc.

II. Alphanumeric Displays:

A proliferation of devices which display numbers and text is appearing on the market. Although the development of the equipment is part of graphics, their programming and use does not require anything more complex than the use of line printers. They are often used to replace teletype printers in time-sharing computing.

III. Interactive Design:

With one or two exceptions no large scale interactive design systems in day-to-day production are available in Canadian industry. Elsewhere a limited number of installations exist for circuit design, automobile, ship and aircraft design, and some other engineering fields, such as piping layouts. No production installations exist anywhere for architecture, graphic design, typography, art, etc.

IV. Computerized Typesetting:

As with alphanumeric displays, the computing aspects of preparing text for typesetting machines, be they conventional or phototypesetting, are not really graphical in nature, dealing only with linear strings of alphanumeric characters. Some systems are being developed for on-line layout and editing (Queen's Printer), and illustration may be added eventually.

V. Computer Animation:

Since the output of a microfilm plotter is directly onto film, by varying the picture frame to frame a motion picture can be easily created for any process which can be suitably programmed. Alternatively, a camera can be placed in front of a display tube. The result of a video display can be recorded on videotape. A number of educational, scientific and art films have been produced in the United States, particularly at the Bell Telephone Laboratories, though progress has been slow due to the lack of software, the cost of the equipment, and a lack of appreciation of the benefits to be gained. Recently a real-time, shaded, colour display of simulated objects has been demonstrated by NASA. This is an active field in Canada, with experimental work having been done at the University of Toronto, the National Research Council, the National Film Board, the University of Waterloo, and the University of Montreal.

The following is taken from a research proposal to indicate the widespread applications possible with various computer animation techniques:

a. Data Display

Data display promises to become an important area of computer graphics. Visual presentation of information allows us to perceive many relationships which are difficult to deduce from tables of numbers. There are many situations in which the relationships we seek are not only distributed in space (e.g. the population of various centers) but also in time, since we are interested in the development of these relationships over some period. These include data available as time series (population statistics, pollen counts, per capita income, sales figures, etc.) transportation data (automobile traffic, telephone calls, information transfer, etc.), stochastic events (traffic accidents, births, and deaths, war casualties etc.), dynamic processes (evolution, blood circulation, weather systems, the operation of a computer under program control, etc.). Such information is best displayed in the form of moving pictures.

Although microfilm plotters have been available for about six years, progress with computer-generated movies has been slow. This has been due in part to the lack of good software in the form of problem-oriented higher-level programming languages with large subroutine libraries. The design of these movies requires a large amount of work, since even a five-minute film will include a large number of different sequences which have to be painstakingly analyzed, programmed and tested.

An interactive display system should speed up the programming and debugging process considerably. By viewing selected frames on the display tube the output can be more quickly visualized and modified. By viewing some of the sequences on the tube (even if only in slow motion, or even if the images have to be simplified for this purpose) the effectiveness of the programmed motion can be studied. If a large number of operations are preprogrammed, including the more common figures and motions used, some or all of the programming may be accomplished by means of the light-pen, function keys, and alpha numeric keyboard.

b. Geographically distributed time series (Population Data)

Vast amounts of data exist in the form of series of values over a period of time (years, days, seconds, etc.) for a large number of locations on a map (of the world, Canada, Ontario, one suburb, etc.). The values at any point of time can be displayed on a map by means of a number of techniques such as circles proportional to the value (the black dots of demographic maps); histogram-like rectangular boxes (or pyramids); figures representing the variable (stick figure for people, dollar bag for money, etc.); shading; elevating a particular region proportionately to the given value,etc.

Between any two successive points in time the data can be interpolated and the appropriate number of intermediate frames generated, resulting in continuous change when the film is shown by a standard film projector. A calendar (or clock) can be added to provide a frame of reference.

Such a moving picture will make evident not only the rate of change of the values, but also the changes in the rate of development (sudden spurts, the levelling off of the increase or decrease, etc.). Furthermore, the developments at the various locations on the map will be seen in relation to each other. The westward spread of population in North America is an obvious example. Techniques for showing more than one variable at a time (e.g. population and income) can also be developed.

The fields of potential application are widespread. Demographic and economic data, medical and educational statistics, production and sales figures are a few of the major types. In the case of many of the developing problems of our society the figures would speak for themselves with dramatic impact through such films; for example water and air pollution, the increasing incidence of lung cancer and traffic accidents.

In addition to the use of the actual data, this technique may also be used to display the effect of various alternative predicted figures, as well as for data obtained from simulation programs.

c. Transportation Data ("Traffic")

Arrows between locations can be used to display volume of traffic. The width or the intensity of the arrow can indicate the volume, and this can be made to change continuously on the resulting moving picture. By showing small objects (arrowheads, boxes, cars, stick-figures) in motion (their number proportional to the traffic density) the velocity of movement can also be indicated.

This type of data can be superimposed over the "population" type of map, so that, for example, the immigration and emigration rates can be shown together with the dynamic population map.

Any type of "traffic" can be displayed including vehicles, telephone conversations, employee transfers and data communication between computers.

Exceptional events can be superimposed in the form of a bright flash, for example, to indicate traffic deaths, communication breakdowns, births, etc..

Both the "population" and "traffic" type of programs will require the following input:

(i) A coded representation of the map boundaries, and the internal dividing boundaries (counties, regions, etc.).

(ii) A list of locations to be used (city, center of a region, etc.) together with their map coordinates.

(iii) The values of the variables at each point (or between each pair of locations), together with the name or code for the location, and the time (or period of time) to which the data applies. In many cases this

data will already exist in a computerized data bank, and only reformatting will be necessary. A library of coded maps can also be set up.

d. Graphic Simulation

Simulation of dynamic processes of other types (e.g. blood circulation, evolution, kinship relations, cash flow, movement of the planets, weather systems, topological transformations) require different programs, each depending on the particular problem.

As an example we may cite the visualization of computing concepts. We see only the static initial condition of the stored program, but must imagine it in a dynamic, changing form to understand it. This has to be done in conjunction with the visualization of the data on which the program operates. We have flow charts, but usually need to trace through them with specific sample data to understand them. To demonstrate a complex sorting routine, for example, we cover large chalkboards with numerous columns of variable data (current inputs and outputs, the state of each index, etc.). In some situations, such as the communication between an operating system and the tasks it is supervising, a dynamic visualization of the process may well provide new insights to the system designer. In other cases such moving pictures will serve mainly as educational and training aids.

e. Cartoon Animation

In addition to the abstract graphic symbols indicated previously, stylized renderings of real entities (human figures, birds, cars, trees, etc.) have to be used. The motion of these must seem believable. A demonstration of the laws of gravity by means of a circle representing a bouncing ball is graphic simulation, but to show two boys playing ball would be cartoon animation according to this terminology. (However, the whole field of computer-generated moving pictures is often referred to as computer animation.)

Cartoon effects can add a human element to educational movies, providing the appeal to feelings which many educators consider essential to real learning. The commercial potential of cartooning is extremely large. However, production costs are high and animation results are generally poor - as one can judge by tuning a television set to any channel on a Saturday morning.

Some primitive cartoon elements have been incorporated into a few computer-generated films, and one or two

papers have appeared in the literature. The development of computer animation involves the solution of many interesting problems. It presents a good vehicle for studying various types of motion, such as the natural movements of men and animals.

On the simplest level the computer could be used merely for the "fill-in" task, interpolating between two given frames to provide the intermediate frames needed for the illusion of continuous motion. The animator could present the two pictures on the display tube. A better approach is to provide subroutines for the most common motions of the usual types of animated figures. To take an example, if the animator wants a flying bird, he would sketch the bird or retrieve it (in coded form) from the picture library (on disc), then draw with the light-pen the path to be taken. The "flying bird" subroutine would then be used to provide the motion, including the flapping of the wings.

Although the conventional cartoon consists of two-dimensional drawings, usually it has to simulate motion in three dimensions. A three-dimensional representation of the figures is necessary, so that perspective can be introduced, the figures can be presented from various angles, and the portions of the scene hidden by the figures can be eliminated. Representation of three-dimensional arbitrary surfaces, hidden line elimination and shading are very complex processes involving large amounts of computer time.

Although stress has been laid on recording the resulting "dynamic graphics" on film, this arises from current technical limitations. Display system with real-time capabilities will be able to generate the images (still or dynamic) upon demand, utilizing programs and pictures stored on mass memories. With a trend toward a "graphic processor" computer as a part of each display system, the display may be at a location remote from the central computer.

VI. Digitized Picture Processing:

This field deals with the computer processing of photographic transparencies. This has received its impetus from the US space program where the Moon and Mars pictures were transmitted digitally and processed through a computer at the California Propulsion Laboratory to "filter" the noise from the pictures and for contrast enhancement. Other applications, so far, have been largely in the scanning of photographs of "bubble chamber tracks" in high energy physics, and chromosome counts, nerve fibres, etc. in medicine. Some development has begun in Canada, for example at the Communications Research Centre. These techniques are necessary for full, automated picture analysis of aerial photographs,maps, x-rays, photomicrographs, etc.

VII. Pattern Recognition:

Closely related to the picture processing area is pattern recognition. Although a field quite distinct from graphics, where visual images are involved, a graphic preprocessing is necessary before further analysis. Character recognition is the most important area commercially, due to the computer input preparation problem. The infantile robot projects at M.I.T. and Stanford use video input for the visual system. The "scene analysis" required is fraught with many difficulties; currently only very regular objects with strong contrasts between faces can be handled.

Software

No full-fledged generalized programming languages for graphics have yet emerged. Most software systems are oriented toward a particular piece of hardware and a particular application area. Thus a potential user has to concentrate on various types of graphics problems instead of his application. Many of the potential users have no programming background at all and problem oriented higher level programming languages with graphic capabilities are required. It would appear that the best approach for now would consist of an "extensible language" in which one of the well known algorithmic languages (FORTRAN, APL, ALGOL, etc.) would have added to it the capability to deal with pictorial data and the basic graphic manipulations (translation, rotation, scaling, etc.). All program modules dealing with specific input-output devices would be separate, so that they could be easily changed for a particular installation. In addition, by means of an operator definition capability the graphics programmer could develop particular sets of problem-oriented operators for each application area. Thus out of the one basic system, languages using the terms familiar to particular applications could be rapidly developed and used by people with little programming skill. Such a graphics language would also be useful for communication between people in describing a particular problem or algorithm. A large number of operators could be stored in a subroutine library, so that the various users could share the development effort. An international workshop has been proposed to be held in British Columbia, which would be the first meeting on graphic programming languages.

In the case of interactive graphics, at the moment a great deal of attention must be paid to "picture regeneration", "attention handling", "menu building", etc.,etc.. Again, no software systems exist which make it simple to prepare an interactive procedure without attention to the many "bookkeeping"problems. The human factors involved in display organization, etc. also require further study.

Since many pictures of interest involve a large number of points or lines and characters, much attention must be paid to efficiency, otherwise even with our fastest present computers some

applications become completely uneconomical. The efficient coding of the pictures (into coordinates) is one of these problems. The structuring of the data (into arrays, lists, rings, etc.) has also received much attention. The representation of three dimensional objects is particularly difficult, unless all sides have plane faces. Surfaces, for example, require appropriate mathematical expressions to be found, or a large number of contour lines stored. Research is proceeding toward efficient algorithms for a number of common problems for which straightforward brute force methods are easy to deduce, but require unduly large amounts of computer time. Some of these are the "hidden line problem", perspective projections, shading, finding whether two pictures intersect, "windowing", "clipping", "shielding", etc. Computers with large numbers of parallel processors would be a great help, even optical computers have been considered, but both of these are still far from realization. Picture libraries share the problems of information retrieval of other material but in addition are complicated by the two (or more) dimensional nature of visual material. A data bank of coded maps, for example, has to be accessible not only by index terms, but also by the geographic boundaries of the area to be retrieved.

Recently it has become apparent to many people working in the computer graphics field that most of the attention has been expended on these technical problems and not nearly enough effort has been made on the development of useful application packages for the many potential areas where graphics could make a significant contribution. Many practical applications with widespread potential are actually relatively simple. Within the next two-three years the "bandwagon" effect may well occur with respect to computer graphics, if the potential benefits are suddenly realized by a large number of users. Canadian organizations have an excellent opportunity to compete equally in the provision of the required software and services. This may well become a major industry within the field, and also open up many new areas to computer use, where calculations and data processing are not the major requirement. Accelerated progress can also be expected in the development of improved input and output equipment, and relatively small organizations with good ideas will be able to make their mark in this field.

Status Quo of Visual Information Relating to: 3. Transmission

Telecommunications Network

Until this decade, the nationwide communication network carried primarily three distinct types of traffic, namely telegraph, telephone, and television. More recently carriers accommodated a variety of attendant services like teletypewriters, telescript, and facsimile. Today, on-line business machines have superimposed a data transfer requirement on the telecommunication networks that range from hundreds of bits per second to megabits per second. These speeds are being met by some judicious rearrangements of existing equipment and the introduction of certain new items like data sets.

The majority of these customers now have business machines which operate at speeds that can be handled on the telephone network. This has afforded many of them the additional feature of random access which is a feature of the nationwide telecommunication network. They can dial nationwide and are usually billed on the basis of time and distance.

It is becoming possible to offer customers random access switched network service for business machines operating at speeds into the kilobit region, and eventually will become possible in the megabit region. The same dialing methodology applies as to customers on the telephone network. In fact it involves the same switching control equipment.

Nearly all the new business machines connected to telecommunication channels in recent years operate in the digital mode. The choice of analogue or digital type telecommunication technology is a matter of economics to interface with these machines, whether they are analogue or digital. A customer business machine can usually have its information pass through a converter to match either basic type of facility. The long term goal is to move progressively to digital type facilities.

In the meantime, there will continue to be improvements in reliability, security, and transmission quality on existing facilities. Hence, most customer data applications can be accommodated over existing facilities until the long term goals are realized.

Many of the more recent business machines appearing on the market are for displaying visual information, television and alphanumeric data. We have attempted to show that communication facilities are readily available to transfer data between these machines. It is difficult to see what impact the associated software would have on point to point telecommunication channels. Perhaps none.

Different Ways of Transferring Data

There are two basic ways of transferring data from one location to another if switching is involved. One is line switching and the other is store and forward switching. Both types have been in use by the communication carriers since the 1930's. Nearly all telecommunication services use line switchers. Information is transferred from one communication line to another through the contacts of relays or other devices. Line switchers thus provide a continuous metallic electrical path which can be tailored to handle extremely wide bandwidths. Some line switchers are designed for television quality requirements.

Line switchers operate under control of dialed or push button tones originated by the user. The common control equipment which responds to these signals employs wired or programmed (computer type) logic to operate the line switches.

Store and forward switching, unlike line switching, operates under control of teletype or similar terminals. For many years the common control was done by electromechanical means. Recently, commercial computer equipment has been built into the network to do this job. A customer's information passes through the computer central processor. There is no continuous metallic electrical path. Switching communication lines through a computer, instead of line switches, provides several advantages and disadvantages. Computers can manipulate customer information to alter, store, or retrieve it. Unfortunately, a computer's ability to switch high speed customer information is very limited. This becomes evident for visual data that approaches television quality requirements. Computers are not used for storing or forwarding television programs, although less demanding alpha-numeric display information is now easily handled by them.

Two things are apparent. Computer methodology is being applied to both line switching and store-and-forward switching (including retrieval services) but in very different ways. And, computers can store and forward visual data economically only if the information content is low.

Computer Programs

When hundreds of customers access computers on-line, they are sharing some of to-day's largest information systems. Large systems have several million "lines" of systems and applications programming. Faults and idiosyncracies occur which cannot be predicted. Programming techniques are needed which will result in controlled, partial, or "soft" failures to avoid a complete shutdown of the whole installation.

Whereas, in the past, failures were inevitably attributed to hardware, the cause of most failures to-day has shifted to the operation system, usually the executive control programs.

The chief reasons are due to their current size and complexity. Some are 50,000 words in length. The overhead in computing capability required to execute the executive routines has grown in size until it is almost unmanagable.

The programmer is no longer dealing with a monolithic deterministic system. Tasks are no longer straight forward. No one programmer or user knows how all aspects of the computer system operate. Many are patching up existing sub-systems leaving less time for the new. Does this lead to an upper limit on the size of a new system ? Perhaps more wired logic will help the programmer's task.

We ask the same question about an upper limit or topping off of computer logic hardware which also includes wired logic circuits. Robert W. Keyes *, covered the technical constraints of building larger logic circuits. His conclusions are worth repeating.

> "Transistorized computer logic has made steady progress towards higher speeds by reducing the dimensions of circuits and devices. However, even though circuit and device speeds have increased by three orders of magnitude since the introduction of the transistor into computer logic, the voltage, current, and power levels have remained about the same. Power densities and current densities have been increasing rapidly as logical circuitry becomes faster and faster. The dissipation of power at increasingly high densities seems to be leading to difficult thermal problems that eventually will limit the progress of logical circuitry toward higher speeds. An estimate of the limit on speed, based on extra-polation of present technology, indicates that the thermal limits derived in various ways are about the same and that they lie about an order of magnitude beyond the speed of the fastest contemporary circuits. Progress beyond this point can only be made by radical deviation from the current lines of development. The most straightforward new method seems to be lowering the temperature at which the circuitry is operated."

In his discussion of speed, size, and power dissipation, the various physical limits derived are not fundamental or ultimate, but technological. Although his examples are taken from transistorized logic, many of the considerations also apply to logical circuits based on any kind of electromagnetic device.

*Keyes, Robert W., "Physical Problems and Limits in Computer Logic" IEEE Spectrum, May 1969.

We have covered a number of computer software and hardware problems. We have focused our attention on the computer core. Its speed and size ultimately places a ceiling on the number of remote peripherals, and on the quantity of information which remote terminals demand. Since pictorial data has a much higher information content than alphanumeric data, it will be the most demanding on time-sharing type computer hardware and software. Will better executive programs help ? To what extend will the application of wired logic help in programming such visual data systems ?

Analogue and Digital Transmission Systems

Data can be transferred over analogue or digital transmission systems. Both are in use to-day.

If the terminal employ s digital circuit technology there are economic advantages to use a digital transmission line. The same is true in matching an analogue display terminal, like a Picturephone station, with an analogue facility. Converters can be inserted to match analogue to digital circuits.

There is rapid growth to-day in the types and numbers of digital terminals because of the proliferation of digital computers. Some people may feel that a digital network should be constructed. Analogue facilities, carry telephone and television services have also grown rapidly since 1940. And, when we are reminded that the telephone network is currently carrying most of the computer oriented business, users and suppliers of visual data display terminals will perhaps wonder what is the long term trend.

The Trend in Data Transfer Capability

We have said that data can be transferred over digital and analogue transmission facilities. We have indicated that it is becoming possible to provide random access to users for the transfer of data at ever higher speeds.

As already indicated we are referring to speeds far in excess of 1200 or 2400 bits per second. Speeds in the kilobit and megabit regions will enable users, with the proper visual display terminals, to obtain greater detail, faster scanning, and colour. User access on demand can extend into the television spectrum. For example, an experimental system is in operation to-day which provides users with dial access television retrieval service. The customer may call a library of video films and view them remotely at his own leisure.

Hitherto most non-telephone communications services were handled exclusively over private lines. The current trend is to provide random access to a switched network for an ever increasing variety of data services. Costs are more closely

tailored to usage. This leads to greater customer acceptance of on-line data systems. The software requirements for private line terminations are different from and probably simpler than the software needed for random telecommunication access of computer "ports".

Transmission of Various Forms of Visual Information

Visual Output	Methods & Applications	Capabilities	Remarks
1. Teleprints	- voice or sub-voice grade facilities - switched or P/L* - via analog and digital channels	- speeds seldom higher than 100 words/m - telephone network at least an order of magnitude faster - channels available for any computer peripheral printer	- telephone network can bring service economically into any business or home - service can be provided rapidly
2. Telescript	- voice grade facilities - telephone network analog channels	- existing telephone facilities adequate for handwriting speeds	- rugged simple method to transmit written messages - output can be flashed on a screen to complement talker

* Private Line

Transmission of Various Forms of Visual Information

Visual Output	Methods & Applications	Capabilities	Remarks
3. Scribblephone (a concept as yet)	- provides an electronic pad for two remote users to sketch on - probably use voice grade analog facilities - candidate for switched telephone network - not a service offering	- a two way visual service which can be carried by voice grade facilities - probably requires two wire facility for data - distance not a problem	- excellent for communicating audio visual ideas - technology probably available but unexploited
4. Facsimile	- usually voice grade facilities - either switched telephone network or P/L	- takes 3 to 6 minutes for letter size sheet over voice grade channels - as brief as 30 seconds for same on wideband channels	- speed dependant on shades and resolution - colour facsimile a problem - terminal device not using capability of line to optimum extent

Transmission of Various Forms of Visual Information

Visual Output	Methods & Applications	Capabilities	Remarks
5. Visual-audio Convertor	- computer reads printed matter and talks - voice grade facilities	- still in experimental stage - useful for the blind - teaching aid	- expensive - great potential for translating into another language with audio output - not yet exploited
6. Alphanumeric Computer Display	- voice grade facilities - switched telephone network or P/L	- distance no problem - facilities readily available - seldom requires wideband channels	- clusters of remote display units sometimes utilize high speed telecommunication channel
7. Graphic Displays	- usually voice grade channels - via analog or digital facilities - short haul PCM probably economical	- more demanding of telecommunication facilities than alphanumeric systems because of speed requirement - P/L often required	- good candidate for wideband switched telecom. network - speed ranges from one kilobit to one hundred kilobits per second

Transmission of Various Forms of Visual Information

Visual Output	Methods & Applications	Capabilities	Remarks
8. Videophone	- via conditioned paired facilities over short distances - PCM over longer distances - combined with telephone channel - conference viewing is voice controlled	- picture details comparable to television - applications not fully explored - good for data applications	- sometimes called Picturephone (R) - requires a one megahertz channel - initial market is business oriented
9. Television	- video cable in large urban centers usually to broadcast studios - long haul over microwave radio across nation - voice channel segregated from picture channel for continuity of service - some switching en-route	- not compatible with voice facilities - capable of handling nearly all visual needs - these are normally 6 megahertz channels	- conference studio human-engineering problems no longer serious - higher resolution desirable - channels not efficiently used PCM perhaps better

Transmission of Various Forms of Visual Information

Visual Output	Methods & Applications	Capabilities	Remarks
10. Movies	- is converted to television type signal and carried on same facilities as television - visual display unit is standard TV receiver	- same parameters as television	- movies have become adapted to the television media - this can become a limitation to higher resolution and innovation
11. Holography	- home colour television reception of holographic programs can be done by pressed pictures on tape	- a coaxial cable, waveguide, or laser beam are three possible means to transport holographic programs	- much development is necessary to introduce holomission - extremely wide bandwidths required - bandwidth might be as high as one to six hundred thousand megahertz - a ten inch by ten inch screen requires about 10^{10} picture elements. Conventional home TV has about 10^5 elements

Status quo of Visual Information relating to:
4. Storage and Reproduction

The consolidation of the modern digital computer in the last decade 1960-1970, as a powerful tool in many areas of our culture is a fact. Every day one hears about new industries for which computer systems are being developed, and of new applications in those areas where the computer has already become commonplace.

Paralleling the application of the computer to process control, and other specialized applications, has been the marrying of communications systems with computers to provide the computer utility industry. The product of this industry is the capability to make available to a remote subscriber the use of an extensive computer facility via a communications link.

The Data Bank

One is inclined to believe that the major use of the work computer facilities by remote subscribers is to carry out lengthy and complex mathematical computations to which the computer is, of course, well suited. While such use is made of these facilities it has been found increasingly that the computational function is secondary to that of a storage function for large volumes of data which must be accessed in order to retrieve information quickly, and/or to update it. A new term is finding some favor for this type of operation, i.e., an information utility.

Where the information stored is of interest to more than one subscriber, a library situation is discernible. One may then refer to a bank of data upon which a large number of subscribers might wish to draw in order to satisfy their individual requirements.

Technical Limitations

Ideally, the data-bank, or visual information store, should have infinite capacity and be capable of being accessed and searched by any subscriber in a neligible time.

Modern computer technology has not yet created a storage system that is ideal, but a hierarchy of storage systems exists, at different costs per unit of storage.

Closest to the ideal are the random-access systems. The main computer memories are of this type. Ferrite material has been the most widely used in this application, but recent advances in plated wire technology have produced random access memories of comparable speed and reliability at lower cost. The situation has not yet resulted in a clear-cut exit for the ferrite core memory tech-

nology. Recent papers in symposia devoted to the computer sciences have shown how highly automated production methods, that reduce labor intensive costs by eliminating labor-dependent operations from the manufacturing process, may prolong the competitive position of the ferrite material random access memory for the next decade or more.

The cost of random access storage is generally very much higher than that on magnetic drum or disc file. The advantage is speed of access.

At the bottom of the list in terms of speed of access is that of magnetic tape storage, but it is by far the cheapest.

This discussion of the hierarchy of data storage systems enables one to speculate upon the possible trends that may be expected in the evolution of remotely accessed libraries of information; and of the role of information stored on film in such systems.

The current random access memory technology, briefly reviewed above, indicates that the costs associated with this category of storage, while decreasing, will not in the foreseeable future achieve a level at which bulk or high density stores could economically be implemented around them.

At any time, there will always be particular system requirements that will need to be implemented with very large random access memories (RAM) but unless the cost differential compared to the magnetic drum or disc-file is justifiable, RAM will not be used in data-bank applications.

The current practice, for large data stores, is to use magnetic disc, or in some cases magnetic drums, for medium speed access ($\simeq$ 18 ms), the magnetic tape for the lowest cost storage.

The costs associated with any of these systems are still so high that only a relatively small number of institutions or organizations can afford them. It will require the innovation of new devices with a lower cost of storage and higher speed of access than the magnetic disc technology can at present provide. One device, recently announced by the Bell Telephone Laboratories, and called a "magnetic-bubble memory", holds considerable promise in this direction. Although there have been few technical descriptions released, it appears that a magnetic domain may be caused to migrate, or spill over, into an adjacent space, by pulsing electrodes at a barrier between the domains. The basic element of this device is a magnetic shift register, wherein the magnetic bubble is the bit of information and its passage across a boundary is detectable. One is thereby led to consider a serial, dynamic memory, with the information circulating in such a fashion that the information sought is accessed when it crosses the detection boundary. The device is non-volatile and hence need not be constantly circulating, and may

eventually be made reversible in the shift direction, which could reduce average access time. However, the salient feature is that a data file, with a volume of a few cubic inches, and capable of holding 1.5×10^6 bits of information while consuming only 0.040 watts of power when being accessed may be available during the latter part of the 1970-1980 decade. The clock rates associated with such a device are expected to be higher than 2 MHz. Thus the access times are variable, depending upon the exact configuration of the system employing the device.

If one tries to compare a magnetic bubble memory with a disc file capable of storing 10^6 bits, and with an average access time of 15 ms, then one needs to achieve a clock rate of $\simeq$ 30 MHz for the bubble memory (8 in parallel) to provide competitive performance. The research effort required to increase this important performance parameter will no doubt be forthcoming and it is likely that the boundary detection problem is the main area in which the work will be done. The magnetic bubble is inertialess and hence, aside from the usual stray electrical parameters, cannot be of major significance in determining the currently announced 2-3 MHz clock rates, expected for the first laboratory devices.

The Data Terminal

Thus far, the remote subscriber to the data-bank or library has not been considered in terms of his capability to handle the information that he might retrieve from that store. It is important, however, in attempting to predict an evolutionary process to see the whole system. The kind of terminal equipment at the subscribers end will be of paramount importance in determining at what point major steps will be taken to implement libraries.

At present the cathode ray tube (CRT) has a predominant role in data terminal technology. Research in solid state display technology has made some progress in number display, but it is not likely that high density, high resolution displays, that are competitive with CRT displays, will appear before the end of this decade. Nevertheless, the coupling of the aforementioned magnetic bubble memory, with integrated circuits and CRT, constitutes a viable base upon which to predict the evolution of subscriber terminals of reasonably low cost with high local storage and digital processor capability. The simultaneous expansion of communications facilities to meet the demands of the computer-utility and data-bank industries will bring about an environment in which the remote-access library concept can grow.

Information Stored on Film

The discussion of the techniques by means of which information stored on film may be communicated[1] pointed out that film

recorded array densities of binary data thus far achieved are in the order of 20 x 10^6 bits per square inch. No other recording technology can even begin to approach this figure. Five feet of film may contain as much information as a reel of magnetic tape. There is, of course, an important difference, the film cannot be updated or changed as can the magnetic tape, and this may be a disadvantage in the presently conceived data-bank operation, but not in the remote-library access situation.

In addition, the information on the film may be in pictorial form. The communications systems' capability to provide on-line wide bandwidth links between subscribers and the remote library are not likely to be so cheap or profuse as to represent a viable basis of operation. Rather, the information in the library will be interrogated via a relatively narrow channel, probably 4 kHz bandwidth, and replies will be sent over the same channel, or in special cases over 50 kilobit/sec switched lines that are likely to be available on a large scale during this decade.

In cities, over relatively short distances, higher capacity channels may become available, but it is doubtful if efficient use can be made of such links without a good deal more research effort to determine how to employ them.

Different Forms of Information

In a general sense, all forms of information recorded on film are visual. To satisfy the appellation, it is sufficient to specify that the information be capable of modulating transmitted or reflected light so that the presence of the modulation be perceptible to the eye of an observer. Information, then, qualifies as visual by its physical presence alone, even if it is not comprehensible to the observer.

Information may be recorded on film in several ways; we do not refer to the photo-chemical process here, but to the form that the information takes. A first category is easily described as pictorial, and the usual description of what a scene or picture contains in the way of form might be lengthy. It is convenient, therefore, to treat this as a general category, and to describe only other categories of images that have special properties.

The set of visual images that belong to the second category are commonly referred to as computer-graphics, that is pictures which may be generated or "drawn" by means of firmware, or computer software, which control of election beams or laser beams, and thus recorded on film. The stipulation is not in the means of generating the images, but in the intrinsic characteristics of the images themselves. A sufficient description of this category is that the image is "synthesized", it is constructed by the linkage of finite number of generated lines or contours.

To clarify the foregoing, consider a computer-generated cartoon. The images themselves may be the work of an artist, but the dynamics are essentially what is controlled by the computer. According to our definition, if a set of programmable functions cannot be used to control an electron beam or laser beam in order to reproduce the image, then the information contained in the visual data belongs to the first category and not to the second.

A third category embraces all those images that contain only symbols or characters comprising the alphanumeric set. A simple example is a picture of a page of a book containing only word text, no illustrations. Aside from the proper specification of scale and language, the visual image is comprehensible to an observer, in a different way than that of images belonging to the first two categories.

A fourth category may be assembled from those visual images consisting of arrangements of spots, opaque or transparent to light in fixed or varying degree, and in which the information resides by virtue of the order in which the spots are created or recorded.

This fourth category is really the most general, because in principle, images of the first, second and third categories can be recorded on film in this manner and reproduced with an exactness or resolution limited only by the particular technology employed.

Recording Methods

Alphanumeric information may be recorded on film as a direct image of (a) a page printed or typed, or created on the face of a display device such as a cathode ray tube, in which case it is said to be "computer generated", or (b) as an arrangement or matrix of spots or holes, opaque or transparent to light, and in which the information resides by virtue of the "order" in which spots or holes are created.

In the first case (a), the information is immediately conveyable to the human intelligence if the image of the material is reproduced optically or electronically for visual accession by the human. For the latter case (b), the information must be translated into the form acceptable to the human.

If the information is to be transmitted from the physical location of the film to a remote or physically removed human, then a translation process is required in the former case (a) as well. In this instance, the translation of the two dimensional image of the material must be from the alphanumeric set to appropriate electrical signals or codes to be transmitted to the destination location, where the human intelligence is assumed to be.

Reproduction and Translation

In order to translate information recorded on film by means of the alphanumeric set of characters, for forwarding or transmission, the material must be scanned, and decisions made on a character by character basis. The result of the scan, line by line, character by character, is to create a time-ordered sequence of codes that may be used to reproduce or re-create a replica of the image recorded on the film.

In the case (b), a scan similar to that used in the recording process, would result in the same time-ordered sequence of codes being generated, and at this point, in the communications system, there is no way of distinguishing which of the two possible origins is responsible for the signals.

The difference between the two methods is apparent only on the film upon which the information has been recorded. The advantage of the direct image for local usage is offset by the need to do more with the information or data if it is required to be transmitted or communicated to a remote user.

Flying Spot Scanner

A particular technique used to carry out one of the steps in the translation process, is to employ a cathode ray tube with a short persistence phosphor, and a means of focussing the spot of light created by the electron beam onto the film transparency; the light modulated by the picture function is collected at a photomultiplier.

An optical reference channel is provided by means of a partially silvered mirror, an identical lens system and photomultiplier and a neutral density transparency.

The control of the electron beam position as a function of time, may be exercised by means of a specially wired system, or small general purpose computer. The reference channel may be used to provide a comparison signal to correct for CRT phosphor intensity variations as a function of variation of x and y (the beam position).

The output of the photomultiplier tube is an analogue time function corresponding to the modulation introduced by the image 'function'.

Line Scanner (Vidicon)

Another technique is to employ a special tube called a vidicon. The image on the film is reflected or projected upon the face of the vidicon, and the intensity of light at every point affects a space charge associated with that point. The output current from a collector electrode is proportional to the light intensity associated with the position coordinates of the electron beam. The control of

the scan or positioning of the electron beam is subject to the same considerations as the flying spot scanner. Again the output current as a function of time corresponds to the modulation imposed by the image 'function'.

Laser Beam Reproducer - Recorder

The density of points associated with spot sizes achievable with electron beams is limited by the physical laws that determine the operation of those systems, to a maximum that is a good deal less than that obtainable with a new technology, which employs mono-chromatic polarized high intensity laser light beams in the recording process, and a lower intensity laser light beam in the reproduction process.

The laser recorder may operate in analog or digital fashion. For our purpose we may consider the digital methods as being particularly relevant to the recording of the codes corresponding to the sequence of alphanumeric characters that comprise the material to be recorded on film.

We are thus led to consider a process whereby a metallic layer on film is perforated at certain points by the presence of a high intensity, laser beam for a brief instant according to a definite format. The net effect is to produce on a micro-miniature basis, the same organization and methodology as is incorporated in the present punched paper tape systems that have been with us for many years.

The densities thus far achieved are 20×10^6 bits per square inch. A comparison with magnetic tape shows that a 2000 foot reel of film may store 8.6×10^9 bits of data; it would require 400 reels of magnetic tape to hold as much, at densities of 850 characters per linear inch of (1/2") tape.

Facsimile

A straightforward, horizontal scan may be used to sustain a translation and transmission of the image sufficient to reproduce a replica at the receiving end. The usual TV image belongs to this classification of 'Facsimile'.

Normally, these are on-line methods, with the translation, transmission, reception and reproduction all occurring simultaneously (except for transmission time delays).

The translated information, in the form of electrical signals may be linear or digital. If the scan is continuous, and intensity variations of the image from point to point are measurable according to some 'grey' scale (scale of shades ranging from opaque to translucent) then these same variations may be modulated onto an electrical carrier signal as phase variations, frequency variations, or amplitude variations, on a linear basis. If some scheme of limiting is resorted to, the modulation is non-linear but, nonetheless, the reproduction of the scanned image at the receiving end will still be possible and, in some circumstances, somewhat improved over what would be obtainable without limiting.

If decisions were made (electronically) at regular intervals in the time during the scan as to the intensity (averaged over the preceding interval perhaps), then a corresponding binary coded number could be generated to carry that information over the communications system to the receiver, where the intensity for reproduction would be determined at that instant by that number.

If the information is dynamic in time, on a frame by frame basis, as in the case of motion picture films, the same technique applies, as it does too for the case of a static frame situation.

Communications Savings in Non-Facsimile Methods

Considerable savings in the total amount of information communicated may be realized when images in categories two or three are concerned. A good deal of the time a 'null' information would be involved and if the content of the image could be discerned, transmission data relevant only to the content would represent a quite different quantity compared to that generated in an unrelated sequential line scan as in the facsimile case.

Category three information, involving only alphanumeric characters, may be transmitted in facsimile mode, but considerable savings in communications are achievable, by a factor of 50 to 100, if the information is first translated via optical character recognition techniques into communications signals, in, say, ASCII Code.

On a more modest scale, some savings in the case of category two information may be realized, if certain features in the image were recognized by a process called 'feature-extraction', and clues as to the manner in which these features are related in the images are thus communicated as basic information to be used by the receiver to reconstruct or computer-generate the image.

In cases when the image is not dynamic or changing with time, the ability to regenerate the image in non-real time, from stored clues,and to update the information as required or requested by the receiver, can lead to very large savings in communications.

For the case of category four images, i.e. ordered arrays of dots, several alternatives may be followed, depending upon the

information content. Modern techniques of laser-beam recording make it possible to record pictures of category one with good resolution; or record images of category three with high density of storage after translation of the alphanumeric content into the communication codes. The dots in the ordered array could very well be the bits of the codes themselves, and one frame might contain a good deal more information than is ordinarily found on one book-page of text.

Future Research Areas

Before the remote-library concept can become a commonplace, it will be necessary to have low cost bulk storage available at the subscribers terminal in order to carry out several functions. The first of these is the provision of an executive processor to serve as 1) a communications terminal; 2) a display controller by means of which data-graphic or pictorial displays are created on the display device (likely to be a CRT for the next decade), and 3) a local storage device so that a large volume of information may be quickly accessed from a central store, stored and examined in a time scale suitable for the human interface, and amenable to intervention by the subscriber operator.

The problem of low-cost local storage is an important research area. The development of a low-cost processor is another. The development of LSI techniques have not indicated that all the problems in this area are solved. The development of miniature computers with powerful instructions for the military,using MSI electronics, shows what may be done, but new processor organizations and manufacturing assembly methods as well as new algorithms must be developed if the labor intensive operations and total cost are to be held to acceptable levels.

The display device itself, dependent upon CRT technology for at least the next five years, would benefit from a solid state implementation in terms of bulk and longevity of the device itself. The main requirement is to reduce the cost, but the complexity of conversion systems from digital to analogue current or voltage, and the attendant limitations on display time or rate of display of points may be significantly reduced in a solid-state system, and that is certainly a research objective.

Finally, turning our attention to the central store itself, one can visualize a variety of intermediate evolutionary steps towards the ideal: i.e., an unlimited store of information, pictorial or alphanumeric, all easily accessible to the remote subscriber through his data terminal, communicating through a port in the central system.

The storage method in that central system is most likely to be "information stored on film" because of the high density with which binary information may be stored on a film transparency, and of the capability of the method for pictorial information as well.

The intermediate steps are, of course, system implementations about disc files and magnetic tape which must yield to the 'magnetic-bubble' memories towards the end of this decade, and overlapped by the development of EBR (Electron Beam Recording) and other recording and reading methods using laser light and photo-sensitive film.

When these system building blocks have reached the proper development, system designers will start implementing systems around them, and if the capital sources of our country are equal to the occasion, funding for the successful innovation of such systems should see them growing in use and size by the end of this decade.

Telecommunication Facilities for Data Transfer in Visual Communication:
1. Present Requirements

Holding Times - Short, Long

The average holding time for a subscriber on the switched telephone network is 2.4 minutes. This has held constant for half a century but may now be increasing. The average holding time for a subscriber of a large Canadian computer time-sharing service in 1967 was measured to be 29 minutes, from a sample of one thousand calls on the switched network. Today some subscribers are interested in polling data terminals just long enough for the terminal to acknowledge itself and send a "yes" or "no" answer of several characters to the computer. This type of holding time is in the range of one to ten seconds. Credit card validation is an example.

Table 1

Column	I	II	III	IV
Service on Voice grade facilities	Subscriber Holding Time in Minutes	Percent of Total Time the Common Control equipment is engaged	Circuit traffic loading assuming	
			1 call per hour CCS #	2 calls per hour CCS #
Polling	0.1	70%	0.06	0.12
Telephone *	2.4	10%	1.44	2.88
Time-sharing	29	1%	17.4	34.8

* Combined residential and business subscribers

call-hour = 36 CCS = 3600 call-seconds

Two features stand out in this table. Firstly, polling service places a high demand on the common control equipment in a switching office (local exchange office), but the volume of traffic in terms of call-seconds is very easy on the outside plant compared to telephone service. Secondly, time-sharing service, of the problem solving type, places a low demand on the common control equipment but puts a heavy load on any cross-section of communication lines. Visual display usage resembles the problem of solving time-sharing traffic. Both of these kinds of traffic can be accommodated by existing types of telecommunication facilities. On-line computer centers have sprung up in many cities like Toronto, Montreal, Ottawa and Calgary. Their telecommunication requirements are being met. Early co-

operation with the common carriers will lead to a better traffic integration of telecommunication facilities and new on-line computer systems.

Setup Times

This is the time required to initiate a call. For telephone service it is the time interval between the off-hook condition at the originating end and the off-hook condition by the answering party. This time averages out to 38* seconds and includes the time to dial at least seven digits and wait for the distant party to answer the call. Immediate automatic machine off-hook at the receiver can reduce this setup time by as much as 22 seconds.

Most data systems require some form of validation of both parties following the setup time. The control processor is seldom involved until the remote terminal is identified as an authorized station. Validation time must be added to the setup time before information is permitted to flow.

Setup time is critical in polling systems. According to the above Table 1 this accounts for possibly 70% of the total time. The setup time is not critical in most time-sharing systems which use the public telephone network. Alphanumeric and vector display systems come in this class. Setup time is often less than one percent of the total time the remote terminal is on-line.

Negligible Transmission Errors

The objective of the telecommunications carriers is to provide satisfactory error performance at reasonable costs. When required, additional protection is possible with error detection and correction equipment. The number of errors can be reduced but not eliminated. Acts of God, such as lightning, are the ultimate barrier to error free transmission. It is a barrier which can be approached but with accelerating costs for both carrier and user.

Beyond technical solutions for solving the error problem, there is much scope in the computer software and system design phase of applications where good procedures can do much to provide error safeguards.

Certain transmission objectives are recognized in the telecommunication industry. There are error performance objectives for digital information and television grade facilities. The objectives and measuring instruments are different for each. No performance objectives seem to be available for graphic communications. In a sense, graphical errors are not as critical as errors in alphanumeric information since single bit errors can change the intent of alphanumeric information, but it might take an error burst to destroy a significant part of a graphical display.

* This average is for local and toll calling

Access from all Points in Canada

About 95% of all households in Canada are equipped with at least one telephone. With rare exceptions these five million main station telephones work out of dial (or push button) exchange centres. Each location is a candidate for on-line data service of some kind.

Satellites will enable additional Canadians to obtain long haul telephone and data services. The transmission quality should be good but propagation time will affect some systems. Those systems which require a return signal will be severely affected unless computers can be programmed to allow for delays which will exceed half a second. Systems which transmit blocks of data at a time, and polling systems may need to be redesigned if communication by satellites is anticipated.

Multicom wideband data service was introduced 1 June 1970 between many major cities in Canada. The service is aimed at those located within seventy miles of major urban centres, since this is where most computers are installed.

Random Access

Random Access means the ability to call any point in the system. Telephone service is a good example. It has had a long history of development.

Various data services appear to be evolving rapidly into random access systems. They are economical and virtually eliminate queueing for service. Random access is therefore desirable but only becomes economical if many users share the costs. Many users access a common telecommunication network like telephone service. The other situation occurs when a single large user might justify his own private random access system such as an airline reservation network.

It is becoming possible to dial a connection and communicate at 4800 bits per second, 9600 b/s, 50 Kb/s, 100 Kb/s or at other intermediate speeds. Higher speed channels will certainly become available into the megabit per second region as demand evolves.

The trend in data communications is toward random access switched network telecommunication service. Potential users include those who are interested in transferring data to visual display terminals.

Flexible $ Rate Packages

There are a number of different ways to charge for telecommunication services. Examples are:

flat rate
fixed basic charge plus usage
flat rate based on distance

volume
time of day
etc.

New packages usually follow demand. Geography and community of interest sometimes shape the way in which services are charged. There are many factors which determine a rate schedule. Recently, new technology, new user requirements, new patterns of usage and innovative rate concepts have led tc to the introduction of a variety of new rate schedules by the Trans-Canada Telephone System.

To illustrate some of the existing telecommunication facilities in use, the following list briefly summarizes the data and associated inter-exchange services as provided by the Trans-Canada Telephone System.

I. Inter-exchange communication services

a) for voice or data transmission

1. All private line services

- private lines

- data - signal and telegraph channels

- Telpak

2. Services utilizing the public telephone network

- WATS, INWATS, Telpak, tie trunks, foreign exchanges, etc.

b) Primarily for data transmission

1. TWX

2. Dataline I, II, III

3. Data-FX, Datapak

4. Multicom service covering voiceband and wideband

5. Message switching data service (MSDS)

6. DATAPHONE service

II. Terminals for data transmission

a) Teletypewriter and associated equipment

b) TWX and DATAcom terminals

c) Dataspeed, Inktronic

d) DATAPHONE, data sets

e) Push button for data, etc.

Attachments and Interconnections

For further details, see Telecommission Study 8 (b).

Developmental Cooperation

The common carrier will support a variety of developments but primarily those which promote the use of telecommunication facilities. Cooperation in the past has led to field trials to test the feasibility of a new technology or service. Laboratory or simulation models are usually inadequate. Stand alone systems have been known to work well until integrated with other systems. The remote display terminal, data set, communication facilities, computer multiplex terminal and the computer itself must function together.

Field trials go beyond reducing a new system to practice. It is important to determine the overall system reliability, traffic performance, maintenance requirements, etc. before further decisions can be made.

Response to User Needs

Telecommunication services are either standard or special assemblies. If there is sufficient customer demand for a special assembly then this service may become standard.

The special assembly approach is a method of responding to a request for service which is unusual or never offered before. For the potential customer its major purpose is to provide him with a prompt reply about the service charge and availability of such a service.

Occasionally the requested service is novel enough to warrant a field trial of the equipment. As mentioned above, the field trial tests the economic and technical feasibility.

Speeds on the Network

When data processing entrepreneurs sought to expand their business by going on-line in the mid sixties, it was fortunate that the public telephone network was available. Previously, those who sought to transmit digital information used teletype channels. Computers were not involved and so speeds of several hundred words per minute were adequate.

Since then because of computers, about fifty different types of data sets have been standardized which not only convert information between digital terminals and analogue telecommunication facilities, but enable users to boost the bit rate at least ten

fold above the capacity of teletype channels. Users could now dial a connection and transmit at least 1200 bits per second with good error rate performance. Some people considered this broadband transmission.

Data service is considered wideband if the speeds involved are beyond the capacity of a nominal four kilohertz telephone channel. Speeds as high as 14.2 kilobits per second have been demonstrated on a 4 kilohertz channel. The upper limit of a 4 kilohertz channel is determined by the signal to noise ratio. The higher the ratio, the greater the capacity. Interface devices provided by the common carriers limit the signal strength to avoid interference on adjacent telecommunication channels, and to reduce electrical hazards to carrier equipment.

For those who wish to transmit data beyond the top speed of the public switched telephone network, it is now possible to do so. Multicom service is being introduced across Canada and will enable users to dial (or push button) a distant connection and transmit data ten times faster than has been possible so far. This wideband service is integrated with the existing public switched network for maximum customer convenience and economy. The calling and accounting methodologies are similar. The same dial capabilities will be extended into the megabit region if the demand is sufficient.

Changes in Data Set Features

The most important data set feature is speed; the right speed. This depends on the business machines connected to these data sets. There are hundreds of different types of business machines which can be connected to telecommunication facilities. It would be unfortunate if a unique data set must be designed for each one. The common carriers encourage cooperation with the suppliers of various machines which might be connected to the telecommunication facilities.

Data sets usually have the following features:

signal conversion
supervision
control
test
interface
line protection

All this circuitry could be built on one chip*. However, until data sets are manufactured in large quantities they will remain as expensive as some business machines. The potential on-line market is covered in Section 5 (d) of the Telecommission.

* New metallurgical and electronic manufacturing techniques now make it feasible to integrate many electrical circuits on a small wafer the size of a button called a chip.

Videophone Facilities 1970-1971

This service will become a reality. Its acceptance will probably be greater in large urban centres. The existing telecommunication plant can be employed immediately. The initial systems will use analogue transmission. This service has great potential for added data features.

The feasibility of using the video station as an interface between man and computer has already been demonstrated. The station displays characters generated by a data set connected to a standard commercial digital computer. Access to the computer is obtained in the same way as a call is made to another videophone. Once the connection is established, the computer is interrogated by depressing buttons on the push button pad of the telephone set. Simple instructions for use of the computer are included as part of the visual display.

A field trial of Videophone is scheduled for 1970-1971. The trial should help indicate the future shape and penetration of the Canadian market. The Americans expect to have between 500 and 1000 units in service by the end of 1970. Videophone set requirements for Canadian market is estimated to be 100 beginning of 1973 and in the range of ten to fifty thousand per year by 1984.

Facilities for CATV Operators

A community antenna television station or system receives signals off the air from broadcasting stations and distributes them by coaxial cable to subscribers.

The Trans-Canada Telephone System Companies provide transmission facilities to CATV operators. Virtually all coaxial cables are in urban centres.

For almost two decades CATV operators have used as many as twelve television channels per coaxial tube. Twenty channel systems are now commercially available and thirty or forty channel systems look feasible.

Information Retrieval Television

A field trial, conducted by Bell Canada, is underway in Ottawa where a number of schools are served by a library or video tapes. In this trial the service is carried on coaxial cables and currently utilizes standard television transmission equipment. People in various buildings and classrooms dial this library and then view their choice of program on a standard television receiver. Many of the transmission techniques are identical to those which serve the broadcasters. The supervisory and control features are vastly different.

The supervisory and control features are exercised by the user with a dial or push button pad. The purpose is to offer each customer the means to access any one of hundreds or thousands of different television records when he wishes.

Requests for service are handled manually or with the assistance of a small computer at the library today. Automatic retrieval of video tapes within the library will be necessary before this service can be offered on a large scale. This appears to be at least three years away if development is begun immediately.

The service need not be restricted to viewing television recordings. Why not permit the user to dial up a live stage or sport performance and be automatically billed by the provider for the service as with telephone service? Any high resolution computer display system could be accessed over this network.

It is therefore evident that considerable technological development is required in two vital areas of IRTV service before it can be fully automatic. A technique must be found whereby a great number of different television quality records can be rapidly accessed within a library. Secondly, a switching system is needed so the user can dial an idle television channel which leads him to the correct playback equipment in the library.

Nationwide Television Networks

The Trans-Canada Telephone System is the principal carrier of broadcast television in Canada. This communication network feeds the various licensed television stations which reach about 95% of all households. Hence any television type visual information can be immediately accommodated between urban centres across the nation. The type of local distribution depends on customer requirements.

Moreover, should the transmission characteristics of a high resolution visual data system not conform to the same specifications as standard broadcast television, these long haul wideband telecommunication channels can be adapted by interposing suitable data modems.

Telecommunication Facilities for Data Transfer in Visual Communication: 2. Future Requirements

Future Capabilities

The emphasis is on capabilities rather than services. While no one can predict customer requirements with clarity over the next twenty years, each day the telecommunication carriers in Canada invest over a million dollars in physical plant, which will probably be in service for twenty years. The most economical way to minimize the risk associated with this uncertainty regarding future customer services, is to design telecommunication plant which can be readily adapted at some later time.

Capital risk can be minimized by good design and judicious placement of the telecommunication plant. Design is controlled by technological innovation and immediate customer needs. Canadian research in telecommunication technology is being applied to produce good designs. This research is often influenced by Canadian distances and climate.

We believe three parameters will govern telecommunication capabilities over the next decade. They are the physical modularity of equipment, bandwidth, and circuit signal to noise ratio. These three parameters apply especially to digital communication channels.

Modularity might best be explained by an example of some existing equipment. The telecommunication industry have in operation an increasing number of pulse code modulation (PCM) digital transmission systems which carry at least twenty-four telephone channels on a serial digital binary carrier at 1.54 megabits per second. The terminal equipment is so arranged that the telephone multiplexing channel equipment can be removed and replaced by data terminal equipment. A family of data terminal units are available and more are coming. The basic twenty-four channel PCM terminal can accommodate, say, one 500 kilobit channel unit, two 250 kilobit units, or eight 50 kilobit units, etc. This is one way of preparing for the future. The PCM system we have described operates over paired telephone wires. Not much has been said about PCM and other high speed systems which might operate over coaxial tubes, other than standard television. Transmission capabilities of coaxial cables are poorly used today. Some carry several thousand telephone channels or twelve television channels, but coaxial tubes could handle much more if suitable amplifiers and terminal equipment were available. This is an area where more research and development will be done in Canada.

Equitable $ Rates

A study in depth of tariff rates is out of place here. This subject is covered in other sections of the Telecommission especially 7 (ab).

Accessing Telecommunication Networks

Before 1962 the Canadian telecommunication network was known as "the telephone network". Since then Dataphone, TWX, Telescript, Datacom, and other services have been added. In fact, part of the basic long haul structure has carried broadcast television since 1952. The physical makeup of this nation-wide random access network is evolving to encompass related services. We have already mentioned Videophone and Multicom which are voice-data services. Dial-up high resolution video may be next.

The telephone set no longer completely defines a telecommunication service. Business machines, computers, display terminals, acoustic couplers, data sets, interface couplers, etc. now terminate many telecommunication circuits. These electrical gadgets function and interconnect with the communication facilities in increasingly complex patterns. Several forces strongly influence the environment. Firstly, new types of terminal hardware continue to flood the market while some current models die prematurely. Secondly, adequate industrial standards are non-existent. Perhaps with greater awareness between industry and the common carriers the peripheral computer business will mature into a family of excellent machines during the next decade. Some species will disappear while others will continue to evolve.

The common carriers expect to develop better data sets and interface couplers together with suitable technical specifications. We also hope industry will modify more computer peripheral machines so they can also operate over telecommunication facilities. Medical machines, computer peripherals, like tape drives, printers, plotters, visual display units, etc., are candidates in many instances. Suitable interface co-ordination could accelerate better use of existing resources.

Higher Speeds

Time sharing is now a highly developed on-line commercial data service. At the end of 1969 there were at least 88 companies providing this service in the U.S.A. and 25 in Canada. Table II illustrates the shape of the American business in terms of types of terminals. Low speed teleprinters dominate. Nearly every company uses them. High speed teleprinters, using voice band or higher grade facilities, are used by 25% of these companies. Close to half of all companies use cathode-ray-tube display terminals or graphic display terminals. Only 10% use card readers.

The teleprinters and visual display terminals (with keyboards) are primarily for interactive purposes. The graphic plotters and card terminals are output units. Most alpha numeric display terminals are not candidates for high speed service (above the present voice band speeds of 2000 words per minute) for most of us cannot comprehend that fast.

There is no clear cut boundary between low speeds, voice band speeds, and higher speeds. Minimum installation effort and expense is involved by the common carriers to place a 1200 or 2000 word per minute telecommunication facility in service to one of the above terminals.

Specially conditioned voice grade facilities will handle any of these terminals to at least 10,000 words per minute or its equivalent in terms of bits per second. System planners who wish to employ visual data display terminals will be attracted to higher speed facilities. However, speeds beyond the capabilities of an unconditioned voice grade line will cost more. Data sets, transmission facilities and the corresponding line switching systems must meet tougher transmission specifications which result in higher costs. However, costs do not increase at the same pace as the speeds handled by the communication facilities.

Visual display terminals require higher speed facilities than any other type, except perhaps, direct computer-to-computer transmission. Dynamic displays with fast moving events will require facilities which operate at megabits per second.

Asymmetric Circuits

A voice facility is a two-way arrangement to carry information of equal capacity in both directions. A television or audio broadcast facility is unidirectional. In the on-line data terminal world, some units, like card punchers, or line printers are always in the receive mode. Consequently a two way channel is sometimes unnecessary.

An increasing number of communication terminals require asymmetrical transmission facilities. These are high speed in one direction, and low speed in the reverse direction. Visual display terminals are an excellent example. We have shown that visual information tends to require a high speed channel.

Table II
88 U.S.A. Time-sharing Companies (End of 1969)
Types of Terminals

Low Speed		Hi Speed		CRT Displays		Graphic Plotters		Card Readers	
Models in Use	No.of Cos.	Models in Use	No. of Cos.	Models in Use	No.of Cos.	Models in Use	No.of Cos.	Models in Use	No.of Cos.
Teletype 33	75	IBM 1130	10	Computer Comm.	18	Calcomp	37	Hewlett-Packard	4
Teletype 35	74	Univac 1004/5	8	Computer Display	4	Complot	3	Univac	4
IBM 2741	40	Univac DCT2000	8	RCA 70/752	4	Data Interface	2	Motorola	2
Dura	38	Univac 9000	7	Tektronix	4	Computer	1		
Datel	35	IBM 2780	6	Burroughs	3	Computervision	1		
Teletype 37	32	G.E.115	3	ARDS	2	Houston	1		
Friden 7100	26	IBM 360/20	3	Datapoint	2				
Friden 7102	12	IBM 360/30	2						
Omnitec	12	XDS 7670	2						
IBM 1050	11	CII Cope	1						
Teletype *	7	G.E. 400	1						
Burroughs TC500	5	Honeywell 200	1						
Terminet 300	5	IBM 360/40	1						
Typagraph	5								
Datanet 730	4								
Teletype **	4								
CDC Marc	3								
Execuport	2								
Olivetti TE 300	2								
ADS 715	1								
Tycom 20/20	1								
Viatron	1								
22 models	83 Cos.	13 models	22 Cos.	7 models	35 Cos.	6 models	38 Cos.	3 models	9 Cos.

* Inktronic

** Portable

The reverse channel is for the operator's use or for supervisory and control purposes. These speeds are seldom more than 100 words per minute. Thus an asymmetrical circuit might be a six megahertz television grade channel in one direction with a telegraph grade channel in the opposite direction. It is technically feasible to build such an asymmetrical telecommunication facility where the difference in transfer rate is as high as ten thousand. But it is uneconomical. Hence where there is such a great difference in speed, each direction will be carried by the most economical means regardless of the reverse direction.

Advertising via Visual Display Terminals

The home viewer of broadcast television pays for most of this entertainment at the supermarket. Will the visual display terminal user accept commercials on his remote terminal in lieu of telecommunication charges? Here, the advertiser would pay the common carrier charges in the hopes that the viewers will buy his products.

While this concept is not new, perhaps its application to visual displays is new. Picture a fifteen second flash on the user's display screen extolling the services of, say, the Oxford-Webster software company every time the data bank, computer, or television retrieval library is dialed. It is easy to think of other examples, but are viewers willing to reduce their costs this way? It could depend on the quality of the advertisements.

Urban Beams

Urban beams may be an economical alternative to coaxial and other cable facilities in certain situations. Beams include microwave, lasers and other means of carrying information through space between two or more buildings. These locations might be several hundred feet or several miles apart. The necessary equipment is no larger than an air-conditioning unit on a window sill.

Some disadvantages are, damage to the eyes and body from laser beams, fog, rain, and lack of privacy from off the air pickup.

There are definite advantages. The common carriers can implement a high speed system very rapidly, and, adapt to a fast evolving urban communications environment. When such beam systems proliferate beyond certain economic limits they might be replaced by coaxial or other secure plant such as waveguides.

Future Blackouts

Telephone service is a residential, business, and thread-of-life service. A great deal of capital expense is incurred by the common carriers to prevent failures in telephone service. Buildings are protected, outside plant is designed to withstand the elements, transmission is backed by auxiliary power plants, and employees are trained to cope with emergency restoration.

The public is generally not conscious of the fact that telephones are powered from the local telephone office. Ordinary telephone installations are not connected to local batteries or alternating current outlets. A local power failure will not interrupt the service. Since this is considered to be an essential service the carriers are not expected to change the continuity of service policy.

This policy does not apply to the more complex telephone services and the other user terminals. Light indicators on the telephones, remote teletypewriters, visual display units, card readers, etc., are powered locally and subject to failure during an electrical blackout. Terminals located in data processing centers may be immune to public power failures if standby power is built into these centers. If these data centers depend on remote terminals then the remote terminals should be supplied with auxiliary power. Most are not, and probably will not be protected because of the additional costs.

As we have related several times, visual data service tends to employ medium or high speed telecommunication facilities. It is economical, for example, to run television grade services via coaxial cables in urban centers. Amplifiers are built into these coaxial cables at intervals of several thousand feet. If these amplifiers are powered by a local electrical utility and there is a power failure in the neighbourhood, service on these coaxial cables will fail too. Such a situation is not as serious as telephone service failure, because the local users' television receivers have also stopped.

Software Inaccessibility

The problem here is not privacy of information but the immense size of software systems. We are aware that some computerized systems are so huge that programming is beyond the individual's imagination. Maintaining the human skills on site to trouble shoot, up-date, and remodel immense software systems may reach a natural barrier within the decade. Firmware, i.e. wired non-destruct readout logic will only extend the barrier to a new but impending limit as to size.

From the user's point there is another area of concern covering software and computer programs in general. One obvious

user question is "what are the rules of the game?" What assumptions have gone into the system which might affect the output of the user's data? Perhaps, unknown to the user, the system is handling his requirements in a very costly manner because of the way in which the software is structured. There may be no rival service organization to point this out.

Potential Applications of Computer Graphics in Next Decade

The potential scope of application of graphic techniques is virtually unlimited. We will stress in this report those areas where remote communication of the data is likely to become an important factor.

Map Production and Dissemination

Our cities do not have reliable base maps of the street layouts, the lots and buildings, nor of the various utility conduits. We have already described some of the statistical type of data which can be tied to a map, and displayed visually. Topographic maps, contour maps, etc. are other items in widespread use, and are expensive to produce.

Display of Statistical Information

Information retrieval systems from large data banks will in many cases require graphic output. Even from non-muneric data banks, the distribution of occurrence of various items which can best be presented graphically will often be required.

Computer Assisted Instruction and Other Educational Materials

Regardless of the material being taught one rarely sees a chalkboard in a classroom with only English text and numbers. We turn to pictorial representation time and again to explain ideas and relationships. Educational technology must take this into account, and educators must realize that this is not merely an "arty frill", but a necessity. Most of television programming is radio with a camera attached, we see almost no graphics, except in the commercials. If rapid means can be found to visualize the news of the day and statistics of the many situations reported on and if this can be done economically our public affairs broadcasting could be greatly enriched.

Engineering and Architectural Design

Circuit analysis, ship, car, plane design, training simulators, structural design, architectural layouts, display of chemical structures are some of the areas in which interactive techniques have already been applied. Graphic output of simulation programs, traffic studies, etc. provide other possibilities. These techniques will make possible the examination of a larger number of alternatives than currently possible, improving the design process. They will also allow the intervention of human judgement into the mathematical design methods emerging.

Medical Computing

Remote transmission of electrocardiographs have been demonstrated. Consultations without time-consuming personal travel require that the communication system offer visual possibilities. The number of microphotographs, X-rays and other material which modern medicine needs exceeds the availability of personnel for analysis. Medical doctors have available to them practically no statistical information; this could be easily provided with the computerized systems which have been proposed.

Air Traffic Control

Future systems can be envisaged which provide the air traffic controller with a real time three dimensional display of the airspace he is controlling, with the position of each aircraft indicated. He will be able to control the scale and point of view of the display. A similar display can also be installed in the cockpit of the aeroplane, together with a representation of the airfield to assist the pilot in instrument landings. The control of automobile traffic, and "automatic pilots" on automobiles will also require computer graphic techniques.

Visual Arts and Design

To quote Maurice Constant of the University of Waterloo:

"Computer graphics, a technique by which the computer generates images--still or moving, on paper, film or tape--has now passed through the research stage and entered the period of development. In consequence, the subject of computer-generated images has now become a matter of direct and immediate concern to the designer and film maker.

"In effect, one of the most powerful tools ever offered to the creative imagination is asking for direction from the user. What would you like me to do for you? What form would you like me to take?

"The sad fact is that up to the present, designers and film makers are hardly aware of the existence of this tool, much less its personal relevance, and where some interest has existed, too often the esoteric language and habits of mind of the computer scientist have discouraged further investigation.

"Nevertheless, some design-oriented minds, industrial designers and architects, have begun to explore the use of computer animation to evaluate structures and sequences. The architect or exhibition designer has been intrigued by the possibility of seeing on film an accurate model of the structure he has dreamed up. He can walk around it or through it, examine vistas, spatial relationships, and evaluate the effect of sequential experiences.

"In general, it is not a matter of inventing a technology, but rather of taking existing technology and putting it together in a computer graphics system directed specifically at the needs of the designer and film maker.

"Hitherto, much of the relevant computer technology has concerned itself with the problems of the engineer, and the need to plot information in the form of a graph. Typical of this concern is the development of high contrast film techniques. However, let us consider the more sophisticated requirements of the film maker--these will include most of the concerns of the designer. Now we must broaden our interest in computer graphics beyond points and lines to somewhat more sophisticated requirements: shape, color, shading, tone, image quality, movement within the frame and from frame to frame ("shot to shot").

"All this implies, too, an interest in the means of manipulating these elements in a meaningful way, that is, according to the conventions of the film medium, and, as well, that the hardware involved be convenient, economical and, in general, more effective than existing film-making procedures.

"What do we wish to achieve? In general, to extend the film maker's powers to manipulate shapes and colors in space; to help him do the kinds of things he has been doing but better, less laboriously, more economically and with greater accuracy. In many cases the peculiar power of the computer make possible the construction of images which are beyond the scope of the film maker. For example, in the field of education, the subject matter of the sciences is full of expository material which suggests or sometimes demands visual capabilities beyond the present capacities of the film maker or the film medium. An obvious instance is the accurate rendering of complex movements or shapes governed by mathematical prescription or which require great numbers of laborious calculations and drawings.

"We must be prepared, too, (a most exciting prospect...) for the emergence of new techniques and modes of expression--based on the peculiar capaabilities of the computer--of whose possibilities the film maker is not aware and which he cannot even imagine. It is quite possible that the continued extension of the film maker's powers in combination with new display and projection devices and ideas such as multiple screen and total image envelopment, will produce not just a difference of degree but of kind--in effect, a new medium."

Many of the possibilities outlined here for the film maker could become equally useful to the visual artist, the art teacher, the graphic designer, the commercial artist, typographer, illustrator, industrial designer, landscape and interior designer, in exhibition and stage design, choreography, and so on. "Computers and Automation" magazine has conducted an annual Computer Art contest (in the August issues) since 1964. "Computers and the Humanities" since its inception in 1967 includes the visual arts in its annual bibliography (March issues).

A major public show: Cybernetic Serendipity was assembled at the Institute of Contemporary Art, London by Jaschia Reichardt. The work of Canadians has been shown in numerous exhibitions in many parts of the world. Canadian students won first and third prizes in an international "Plotter Art 1968" contest. The report of the "Telecommunications and the Arts Seminar" documents this area in more detail.

Our government agencies deeply involved in the visual media should become leaders in the uses of the new technology (e.g. National Film Board, Canadian Broadcasting Corporation, National Gallery, National Arts Centre, Canada Council, Information Canada, Dominion Bureau of Statistics, National Library, Queen's Printer, National Research Council, Communication Research Centre, etc.). Since the new developments break down the boundaries between media, interdisciplinary work is vital, and the different agencies must learn to work together, and also open up their doors and facilities to outsiders.

New Services Anticipated in Next Decade

Service

The user's terminal, the transmission path between this terminal and some remote point for either receiving or transmitting information, together with a timetable, etc., all add up to something called a service, which the user agrees to buy (directly or otherwise) from one or more providers. From the user's point of view no one part of this chain is a service. For example, the flat solid state television screen being developed at the University of Waterloo may lead to one but is not a potential service in itself.

Some Anticipated Services

Among the services we expect to see evolve in the coming decade are Videophone and Multicom wideband data service. These services will appeal to certain large segments of the population.

The long term prospects for computer services are covered in the report of Telecommunications Study 5(d).

Videophone service may be useful to some businesses, an attraction in some homes, and a necessity perhaps to deafmutes.

Three dimensional holography, voice print recording, interactive display terminals without lightpens or keyboards, and others, could lead to new services.

Modifications to Existing Services

Some coming events are modifications to existing services: better human-machine relationships, self service trends, e.g. direct dialing overseas, and better quality of services. This better quality expresses itself in terms of faster setup times, a variety of (data) speeds, low error rates, and costs which might be somewhat independent of distance.

Predicting New Visual Services

Everything technically possible will not happen. Social and geographic disparity, our value systems, monetary restraints, allocation of resources, and the policies of business and government will filter the possible and introduce the acceptable at times and places which can only be guessed at. Some trends make predictions easier. UHF television reaches over thirty million USA households. Its current introduction in Canada may spark the following events within five or seven years and top off about 1985:

- more television channels for the home
- more television sets per household
- greater acceptance of coaxial cable connections to homes
- thirty or forty TV channels per coaxial tube
- centres for switching television channels
- more local live talent
- automated film libraries
- home video recorders to capture TV programs
- accelerated changes in social goals and values
- further social pioneering by governments
- etc.

Delphi Study Results

Bell Canada is conducting a Delphi study to probe the educational, medical, legal, etc., fields for indications of trends in telecommunications. The study which is a method of arriving at a group consensus about opinions regarding the future, covers the next thirty years. Questionnaires have gone to hundreds of experts across the continent. Some of their opinions are now available. Here are a few views covering visual data services in the educational field.

1. Implementation of laser and hologram technologies for storage of vast amounts of digital and visual material in a very small area will occur during this century but not before 1985.

2. New computer logic systems will be developed which will not only store information, but relate it and so allow computer intelligence. This will occur sometime but not before 1986.

3. Retrieval, information retrieval TV, computer aided instruction, etc. will not make schools irrelevant before 1990 if ever.

4. Fifty percent of the respondents feel the following computer output capabilities will be in 20% of the locations designated sometime during the following periods:

	Output	location	time-frame
i)	computer voice reply	- homes - schools	1981-99
ii)	printed page	- homes - grade schools - post secondary schools	1981-97 1970-85
iii)	traditional television screen	- homes - primary schools - secondary schools - post secondary schools	1981-99 1981-90 1976-90 1976-85
iv)	large flat television screen display	- homes - schools	after 1986
v)	audio-video recorder for recording	- homes - primary schools - secondary schools - post secondary schools	1981-99 1976-99 1976-90 1976-85
vi)	Videophone screen display	- homes	1981-99

Social Aspects of the Use of Computer Graphics

Importance

We produce vast amounts of data by computers, and communicate great amounts of information. In some instances fork-lift trucks are needed to transport the computer printouts. These can only be understood, comprehended and used if they are organized into meaningful patterns. The most effective way of doing this is visually. The interrelations of the many factors we need to take into account in considering many of our problems can best be done visually. The complexity of our society and of our institutions makes the use of computers and of computer graphics real necessities. For proof we need only observe for a while most face to face communication where invariably sketching, drawing, plotting, outlining, etc., occur spontaneously.

Group Area

As the possibilities are realized and the needs felt this field promises to be a growth area within the computer field. Graphics will also serve to open the door to many new computer users for whom current communication means with the computer are unsatisfactory. Some research studies, for example, are moving toward the graphic specification of procedures for the computer. Before really widespread use will be possible the cost of equipment will have to decrease and the software will have to be provided to make its use easy. Due to the cost and complexity of maintenance central service facilities will be needed. The research and development effort should identify the areas most likely to be of help to society as a whole, and out of these begin with the ones easiest to achieve technically. The systems developed should have general applicability, rather than being for a specific application on a specific piece of equipment. Much can be learned from the development of the rest of the computer field, without going through the same painful steps with graphics. While we need to alert potential users to the possibilities, we must not oversell it, and promise things we cannot deliver--there is already much disenchantment with computers because of previous unfulfilled promises.

Visual Education

Our school systems tend to neglect the education of our visual sense. Many existing facilities in the graphic arts are underused because of a lack of appreciation of their value. In one university physics department a few years ago a list of physics films was circulated, which were to be made available without charge. Only one professor expressed interest. However, now the same department has a committee on educational technology, and is becoming interested in computer animation. They want to make their own! The

filmmaking going on in the high schools is another positive sign. It also has to be recognized that most graphics serve their purpose in a short time, and need not be of a quality to be preserved for the ages. Gyorgy Kepes' Vision/ Value series of books constitute one of the best resources arguing the values of visual communication.

Future

The best uses of the visual data transmission possibilities will be to bring the non-numerate but inherently visual citizen into the picture. Those specializing in a field and intimately familiar with its intricacies can usually deal with it in an abstract manner, and are able to visualize the relationships and processes involved without external aid. They are not even aware of the needs of those less gifted in their field, which is one of the reasons why many teachers are less than illuminating to their students. For example, future mathematicians can absorb most of their mathematics exclusively by means of symbols, the rest need graphic visualization.

Information presented graphically tends to have a far greater emotional impact, it leads more often to a "Eureka" gut-feeling, an "Oh, now I see." And what we need if our data is to have any real value, our information explosion any real benefit is understanding, insight hopefully leading to wisdom in making our vital decisions. In a democracy we are committed to the principle that this cannot be delegated, that the whole citizenry should be informed, so that he can fully participate in the social process. This includes not only the interpretation of what has happened already, but also the prediction and evaluation of alternate future courses of action; we must all become futurists in a rapidly changing world, or we will lose control.

Everything that has been said so far refers to the near future, all these things are possible now, and will likely become economically feasible within the next five to ten years. In the more distant future other exciting vistas exist, but will only be mentioned here. We should remember that utopians and science fiction writers speculated about many developments fifty and even a hundred years in advance. It took 300 years from Pascal's machine to develop the computer. Many of the implications were foreseen by Lady Lovelace, considered to be the first programmer (to Charles Babbage and his Analytical Engine) one hundred years ago. Technological advances which make these things feasible are hard to predict. However, we can look in our crystal ball, and see the home entertainment and information center, with access not only to the supermarket and the world's libraries, the stock exchange and the race track, but also to the world's art collections, movies, video tapes. And this available not only to the megalopolis housewife, but also to the Arctic Eskimo, and the sailor on his ship. Not only will he be able to select what he wishes to see, but also interact with this and alter it. Each of us can be a "citizen artist" with the help of the new medium. We will

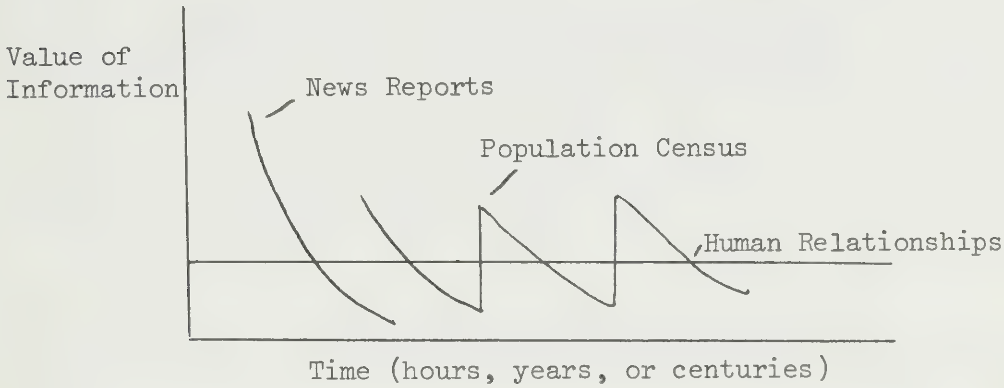
be able to enter the communication stream ourselves, sending messages, poems, sonatas, pictures for others to see. These are worthy aims to move towards, but we will not have them within the next ten years.

Potential Social Effects
of Increased Demand and Use of Visual Information

Information Decay

Information does not become more useful with time. It decays. Table III illustrates several kinds of information and the corresponding influence of time.

Table III



Most of us can act on "perishable" information only because of fast telecommunications, and the way in which the information is portrayed. Visual display equipment is very effective for this purpose. Television and Videophone services are powerful examples of how current information can be disseminated.

Computerized data banks operate with visual display terminals for reasons which go beyond the perishable nature of information. Information decays into data. Its value becomes relatively constant with time. If a sufficient amount of it is hoarded properly, it can be analysed and rearranged to provide interesting relationships, which might be interpreted as "new information".

Computers do an effective job of this only because they can store vast amounts and can be readily accessed. Let us add, however, that none of this happens without good software; software which is based on an efficient accessing scheme.

It seems we cannot have fast access to vast amounts of data without creating problems that require rigid control. Here are a few key items:

- Every citizen will not have the skills or the terminals to make meaningful use of these data bank facilities.

- Our national manpower resources will not permit a great deal of duplication of data in each data bank. It is expensive.

- Updating and purging are essential to remove dead data and minimize errors. Visual display terminals offer one rapid means to scan files, even on a statistical basis, for monitoring what is in data banks.

High Information Impact

Visual information has greater impact on individuals than audio or printed information for a given unit of time. As the rate of information is increased it becomes impossible for a person to comprehend every detail. One's psyche compensates for this problem by interpreting the vast amount of detail as it is presented. All the interpretations are transformed into a meaningful message to the observer. Since a visual display terminal can do this faster than any other type of output terminal, the impact of this medium is greatest.

Visual display units have their own hierarchy of impact which increases roughly in the following order:

- alpha-numeric displays
- vector displays
- Videophone
- television
- cinema
- 3D colour holography

Conditioning People Rapidly

One social consequence of the visual display technique is to condition viewers rapidly to new ideas. While the ideas might be good or bad the key is speed. The visual display medium is and will be instrumental in broadening our horizon of experience and shaping our value systems. The Japanese had a post-war population problem. Radio , television, and the newspaper media were used to bring the birth rate down as rapidly as possible. The message was simple although the consequences were complex.

The ecologists have acquired a large reservoir of data and are turning to television to proclaim the perils of pollution. Even the message is complex. Time may not permit them to present it any other way.

In recent decades, political electioneering has become expensive. The visual telecommunication media is being brought to bear to shorten this appeal for votes.

The Apollo 12 did not seem nearly as exciting as its predecessor. Apollo 13 did, of course, for unique reasons. People condition rapidly.

To cope with the information explosion, educators and business are hoping to employ more effective technology like teleprinters and information retrieval television for students, and, computerized plotters for industry. Visual display systems now present pictures which cannot be seen in nature. One example is a see-through three dimensional rotating object.

Learning how to read and write takes a long time. Getting life's messages by television first and learning writing and reading later may be a viable means to help the young, the poor, and those in remote areas. Satellite communication will offer a splendid opportunity. It is a large quantum step beyond transistorized radio receivers in remote areas.

Conclusions

Visual means of communication has been one of the most effective forms used to transform sensory data and abstract phenomena into meaningful and logical patterns for easier interpretation and understanding. Much of our human experience relates closely to both static and moving images. Their judicious portrayal offers a great deal in fostering an interpersonal relationship and in enhancing the transfer of ideas, concepts, thoughts and knowledge.

Our way of life has been influenced by conventional visual information that has been communicated to us by means of television, motion pictures, and printed material. The capability of the computer is continuing to progress rapidly. Input/output devices providing mostly alphanumerics are becoming inadequate as a means of communicating with the computer, particularly in an information and data systems environment.

As our society becomes more complex and the amount of information to be absorbed and utilized continues to increase, there is a definite and urgent need to convert computed data and problem solutions from computer output into visual data. In this instance, visual data is synonymous with pictures and graphics which depict static patterns (points, lines, curves, drawings, diagrams, graphs, charts, shapes, shades, structures, characters and colors) and moving pictures (time-dependent functions, changing movements, sizes, perspectives and forms) for more effective interpretation and decision-making. Such visual data display shares much of the communication effectiveness of conventional media, e.g., television, film and printed material.

For any information and data system to serve the many needs of man effectively, a closer partnership must be developed in order to blend the creative and reasoning capabilities of man with high-speed manipulation, processing, and large scale storing and retrieving capabilities of the computer. Both are required to closely interact with each other.

The visual aspects of information and data systems have been enhanced considerably by individual development of input, output, telecommunication, storage and computer technologies, as well as in computer graphic techniques. There is growing trend in combining these technologies and techniques in a variety of ways in order to provide a flexible and economical means of visual communications. This is also supplemented by new processes developed in conventional media and audio-visual devices.

Visual data display is an effective man-computer interface. It can improve the dialogue between man and computer to a level that is visually comprehensible. The trend of visual data display developments in the next decade will lean more heavily toward the cathode-ray-tube (CRT) than other types. This is due primarily to the many

different applications of the display in transferring visual information from one media to another: e.g. as microfilm recorder, phototypesetter, scanner, facsimile transceiver, optical character reader, optical pattern recognition system, image converter, etc.

Such CRT visual data display will be used increasingly as remote time-sharing terminals for information retrieval purposes. Color, graphics and interactive capabilities will be gradually added to basic alphanumerics.

The television set or video monitor will be employed as a display device for low-cost terminals. It will become the most common type of input/output device for information and data systems to be used in office, schools and eventually in the home.

Computer graphics is a very important field in the realm of information and data transfer. Many new developments and rapid advancements have been made in its techniques which have increased computer applications and capabilities to a great extent.

Through the universality of pictures, computer graphics have proven most effective in the transfer of information between man and computer. It enables one to visualize abstract concepts and invisible phenomena. In addition, the quantity of transferred information is substantially compressed and is more readily interpreted, while the quality is vastly improved. In generating and displaying information in a dynamic form with a programmed and changing time factor, interrelating events and situations can be accelerated or slowed down to suit the individual's communication needs.

Potential applications for the interactive mode of computer graphics augment man's intellect and decision-making abilities. This gives him insight into old and new problems and provides him with a new and powerful tool. He is thus able to conduct wide-range exploration and applications for scientific, engineering, educational, governmental and artistic communities, particularly in areas of problem-modelling and simulation.

Through special graphic programming languages and subroutines, man and computer communicate in visually-oriented terms. This enhances the interdisciplinary approach to problem-solving as well as encourages solutions to be reached by trial and error or experimentation.

A more sophisticated method in computer graphics has been developed by converting computed data into conventional video signals. These are fed to television monitors or large screen television projection systems for display. Such a technique lends itself to the simulation of a variety of visual environments for training and pretesting of concepts; e.g. urban planning, transportation system study, air traffic control training, etc.

While optical character readers will be used to eliminate input delay by converting hand or printed characters into machine acceptable form, optical pattern recognition techniques will also become increasingly important as the development efforts in computer graphics continue to improve.

Another important factor in the rapid growth of computer graphics is the availability of the microfilm recorder employing CRT display to obtain graphical output in the form of hardcopies, microfilms or motion picture films.

Increasing use of the CRT and electron beam types of microfilm recorders will be made to convert computer output onto microfilm. Substantial savings will be achieved in time, cost and storage space, as well as easier retrieval. Microfilm is continuing to gain acceptance as standard information media by libraries and professional organizations, government and commercial companies. As the graphic quality of the CRT display continues to improve, more conventional printed material will lend itself to this form of micropublishing.

The microfilm recorder will also be used by research organizations and educational institutions to produce computer-animated motion pictures on scientific and engineering subjects in communicating research findings and serving as teaching aids. Uses will gradually be made by management in budget and manpower forecasting, etc. in assisting decision-makings.

Microfilm application to graphic arts printing and publishing is becoming important. Electronic phototypesetters employing high quality CRT visual displays are being used for generating hard copies by photographic or xerographic process.

In the printing industry, text processing and remote CRT display terminals will be used for on-line reporting, preparing, editing, retrieval, proofreading and page make-up, etc. Both texts and graphics will be composed on interactive display consoles. Central or remote optical character readers will be used to convert handwritten copies and other printed characters into machine acceptable form. A laser system will be used within the next few years to digitize graphic material for computer storage and processing, as well as for milling high precision plastic pressplates or for producing high quality film masters for lithographic printing.

As printed material and film images and computer data from data banks can be converted into coded information for transmission over telecommunication facilities, there are increasing efforts in applying information transfer techniques along with other technologies to meet various visual information retrieval and distribution requirements.

Increasing uses of portable facsimile devices to transmit hardcopy over normal telephone lines for remote reproduction: Microfilm is scanned and converted into digital form and presented over CRT display terminal for editing, updating and then recorded on a new microfilm frame; use of video tapes to store record files which, under computer control, can be remotely displayed, sorted, updated and printed out.

Conventional visual media such as film and television can also serve a variety of visual information needs. Many creative uses have been made of such media, not only to transfer information but to entertain, to convey human emotion and experiences, and to motivate social and political awareness. However, the very restrictive distribution methods of films and the rigid programming schedules of television have inhibited their accessibility to individuals as flexible information tools.

Recognition of increasing demand for a greater variety of visual information and freedom of choice in selecting the type of program one may wish to playback at any time over his home television set has resulted in recent developments in prerecorded video cartridges (EVR, SelectaVision, AVCO), video cassettes (SONY), and video players. These devices will become very important visual information tools for education, training, cablecasting, publication, knowledge industry, advertising and entertainment.

Rapid expansion will become significant in coaxial cable systems reaching increasing numbers of homes as a vast visual information distribution system. It can provide a variety of entertainment, educational, community-sponsored as well as informational programs, and with capability of upward of 40 channels, the choice of selection will no doubt be enormous. Coupled with a video recorder which is capable of automatically recording programs from any pre-determined time, the viewer has the ability to retain programs and other visual information for use at a later date.

A cable system is able to deliver to the home viewer a cleaner video signal and higher resolution (1000 scan lines). A video facsimile unit, coupled with a high resolution television set, can be used to produce hardcopies on transmitted graphical material.

Future two-way cable systems can also provide a means of on-demand selection and retrieval of a variety of visual information from a central storage. It can also be used as a high speed data link between a time-sharing computer and a remote graphic terminal, with the television set serving as a low-cost display unit.

Remote computer graphic techniques, dial accessible wideband data networks, multi-channel cables, video cassettes and cartridges, video recorders and players, coupled with television sets capable of high resolution and color, will have a tremendous impact on motion picture and broadcasting during the next decade. While 16mm and super

8 films, slides and filmstrips, continue to find applications in industry and education they will be increasingly challenged by the more flexible and versatile EVR, SelectaVision, VCR, and other similar systems.

Production of film as a contemporary art form will gradually trend toward a total visual experience creating sensory stimulation and feeling of involvement. It will integrate multi-media, sound, light and architecture. Excellent examples of this imaginative use of film and of the new designs in film equipment have been seen at EXPO '67 and EXPO '70.

Successful integration of information transfer techniques, time-sharing and computer graphics for visual information communication demand flexible, expendable and economical telecommunication facilities. Continuing developments are being made in Canada to design new and to improve existing telecommunication systems to accommodate a widening range of visual information services.

Common carriers offer a variety of data services which are carried by analog and digital type transmission facilities. Heavy investment in these facilities continues, with the emphasis on digital systems and faster switching capability. A switched telephone network may take the bulk of the lower speed data services across the nation but a random access switching service is being extended now to cover higher customer speeds.

Visual telecommunication services generally require at least the capability of a voice grade facility. Many alphanumeric and graphic applications come in this range. Displays depicting motion or great detail are normally carried by high capacity facilities. Videophone and television extend bandwidth requirements into the megahertz region.

There will be an extensive growth in the use of remote on-line computer display terminals during the coming decade. Videophone retrieval of computer information will be a service offering. Dial access television retrieval service is also a likely possibility.

Telecommunications is a capital intensive sector of the economy. A high percentage of equipment like towers, cable, and conduits will remain in service beyond ten years; a substantial part of today's plant will carry telecommunication needs for the next decade; the framework is already built and we can expect some telecommunication surprises in this time; technology, in the research stage today, may not penetrate the mass market by 1980. However, most important of all, is how we use our current resources.

In Canada, some commercial activity is being excited by essentially U.S.-originated plans to make use of a telephone-switched network for slow-speed inquiry and a coaxial cable network for high-speed visual display. Access to these facilities could be provided to business premises and individual households.

There will be a gradual introduction of inter-computer communication systems, such as ARPA (Advanced Research Projects Agency) computer network in the U.S. This would allow a large number of remote users to share and pool much of their computer resources, as well as permit many individuals working on graphic-oriented problems to exchange information and interact visually.

In a computer-based information service environment, a wide spectrum of users will be operating on both digitally and pictorially stored data. The next few years will see randomly accessible massive digital storage in use with film as the storage medium because of its high information storage capacity. Laser and electron beams will be employed to write, verify and read digital data stored on film. Pictorial images will be recorded on microfilm. Visual information will be retrieved by means of microfilm-to-facsimile techniques, and microfilm records will be digitized and read back to the computer for subsequent manipulation and display.

Laser and holography will have their impact on information and data systems. During the next decade a number of practical applications in image storage and display will be developed --- an holographic memory, capable of storing massive digital and graphical information, will give speed and economy to printing applications and computer-based libraries; two-dimensional laser color televisions will be refined into marketable form; three-dimensional holographic motion pictures will be used increasingly in research, and the first commercial three-dimensional motion picture will be demonstrated to the public.

Hardware, software, communication and transportation costs, as well as application, accessibility and freedom of making selection and utilization will determine the most viable visual information service in meeting individual needs.

The Canadian electronic industry appreciates that the communication of visual information is becoming increasingly important, and companies are therefore allocating much more effort to research, development, production and marketing of the range of equipment required.

The enormous growth of interest in this field by so many different organizations and individuals and the wide variety of their requirements indicate both the large potential and the problems a company encounters in deciding which product areas to develop, and the precise characteristics of selected products.

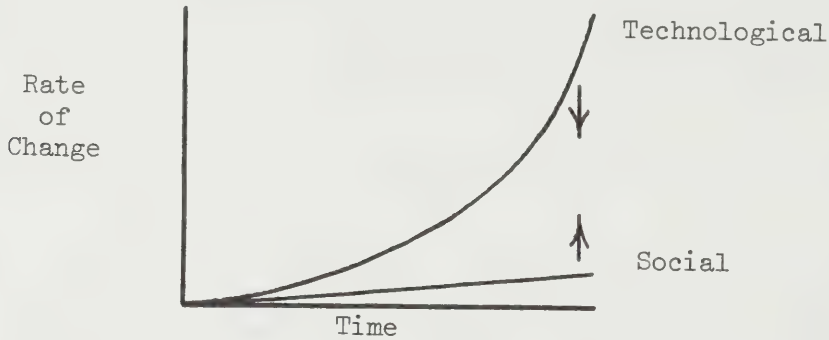
Also, in any rapidly developing field such as visual data, the Canadian electronics industry is sensitive to what is going on south of the border since, through its vast size alone, American industry is certain to come up with a wide range of products, some of which will be winners; whereas Canadian industry must be much more selective and the risks of failure are greater.

Canadian electronic industry is at present producing a range of visual display systems. Examples of these are: Flight information processing and display systems for airports; information processing, storage and display systems for stock exchanges, hospitals, banks, etc.; colour CRT display systems for process control for power utilities; various other CRT displays for computer interface, radar, etc., character generation equipment for characters up to 24" in size; development of a flat screen display. Data entry keyboards are being manufactured, and videophone equipment is under design. A selection of data transmission equipment is in production from low speed (teletype) data modems through 9600 bps, to pulse code modulation.

Problem Areas and Technical Objectives as identified by the Canadian electronic industry: The industry is most conscious of the need to reduce the cost of all system components for visual transfer, especially visual displays and hard copy, and optical character recognition. Resolution capabilities, stability, modularization, reliability and ease of maintenance are among the objectives in the display area. A variety of standard data terminals will be required, together with a considerable number of data banks. Concentrators, multiplexers and other interfaces require maximum standardization. Data modems up to speeds of 9600 baud, and digital transmission systems are required, together with measures to increase transmission speeds on switched telephone networks. Video information should be compressed to reduce redundancy, and the upper frequency spectrum utilized for transmission of video colour and digital data. It also appears that the development of a cheap and fast facsimile system for use on telephone lines into the home/office for remote correspondence and general information purposes may be a requirement. The industry appreciates that the expected general increase in visual communication will have a considerable sociological impact, which must be considered in the formulation of future policies and plans.

The complete field of audio-visual education will be influenced by widespread use of "visual data" communications and display. Training courses will be needed to qualify people to work in areas of human impact and social betterment. The "learning-program" concept, if implemented on a wide scale, will require thousands of people in the next two decades to research and create programs that may become schools of the future. Thus, there will be a need in Canada to provide useful employment for large numbers of technologists and scientists who will graduate every year. These people will have increasing knowledge in computer sciences and awareness in visual communications. Financially this will, on the one hand, be a great burden to the taxpayer, while on the other it will be most beneficial to the country as a whole.

There is a steadily widening gap between technological developments in visual communications and rate of social change. The privileged gain access to vast stores of information and continue to progress, while the less privileged remain deprived. We could lessen this disparity by developing in quantity and quality user-oriented hardware and software which would be more easily and more economically accessible.



There is need for Canadians to pursue actively all aspects of visual data telecommunications. Recent technological developments have clearly demonstrated the feasibility of the many possible applications, as outlined in the Study.

Much hardware is readily available at the present time, however there is considerable work to be done in areas of graphics-oriented software and applications. Such an enterprise would challenge as well as stimulate the imaginative and innovative capabilities of Canadians involved professionally.

Information and data systems and visual communications have good market potential and extensive social benefits. We should therefore make a concerted effort to assure Canada the leading role in this unique undertaking.

Some Recommendations

Information Assessment: Establish and maintain good communications for the interchange of information among government, universities, electronic industry, common carriers and service organizations in various technological and application aspects of visual information communications.

Active Involvement: Encourage those government departments and agencies that are involved in visual media to take an active role in exploring potential uses of new technologies and developing new applications.

Study Updating: Update the work of this study and the national goals and objectives derived therefrom. A multidisciplinary approach be adopted and full consideration be given not only to technical, economical, educational, cultural and social aspects but to the well-being of Canadian industry. There will also be federal-provincial government discussions in some areas of which education is an example.

Advisory Body: Form an independent advisory body to advance the many aspects of visual information communication as prescribed in this study; to formulate objectives and to promote all phases of research and development efforts to assure that Canada plays a significant role in application and utilization of these new technologies. It is proposed that C.R.C. (Communication Research Center) be instrumental in initiating this group.

Future Experimentation: Promote and implement trial or experimental systems that will serve several purposes:

(a) provide a basis for development of both firmware and software techniques relating to analysis and display of visual data.

(b) provide a basis for development and research into new hardware devices to exploit newly applied physical principles to improve the system.

(c) investigate feasibility of collaborative research and development programs between government, universities and industry to sustain a high level of competence and assure best possible use of available efforts and resources.

(d) promote development of "human-oriented" visual displays used in information and data systems by overcoming problems in hardware, software and systems operations.

University Research: Encourage and financially assist the formation of research and development projects conducted in universities. Devise ways of bringing these results through to a commercial reality.

Computer Graphics Industry: Encourage the growth of a computer graphics industry in Canada, particularly in hardware, software, low-cost display terminals and new services. This is potentially a high-risk industry but holds promise of innumerable applications and benefits. Industry will need increasing financial support from government, including some substantial government funded research and development projects.

Public Education: Improve methods of making the public aware of the many benefits of new forms of visual communication. For instance, computer graphic techniques in conjunction with visual data from meteorological and earth resource satellites can generate a variety of visual environments for the study of causes and effects of weather, pollution, etc.

Cultural Exchange: Encourage cultural interaction through new forms of visual communication techniques on a national and international level, particularly in exploring different approaches to various problems, furthering understanding, establishing new relationships, etc.

Arts and Technology: Promote the interplay between creative artists and computer specialists in the use of remote visual display and computer graphic techniques to engage jointly and interactively on a common program, such as development of new visual designs, sculptures, animated motion pictures, educational material, other interdisciplinary applications, etc.

Standardization: Develop standards of the characteristics of visual display terminals, interfaces, data sets, and transmission systems. Standardization will assure equipment compatibility and reduce the dissipation of effort on low-value special developments. The concentration of fewer products will reduce costs and accelerate growth of visual information systems. Establishment of standards will enable potential users across the country to communicate in this new visual manner in more sophisticated and complex ways.

Canadian Content: Maintain a prescribed level of Canadian content and regulatory control in the visual aspect of information and data systems of the future. Planning should start now for the use of government funds to supplement individual Canadian enterprise in its continuing struggle to survive economic and cultural tidal waves from south of the border.

Appendix

Radio and Electrical Engineering Division
NATIONAL RESEARCH COUNCIL

Data Systems Section
Submission to

Telecommission Study 5(g)
"Problems in data transfer with
particular regard to visual data"

1. Status quo with regard to generation, transformation and transmission of different forms of visual information.

Our discussion is limited to the field of computer-driven c.r.t. display data as this is the area in which we are active and knowledgeable.

Currently transmission of visual data is not widespread in Canada. Visual data is usually generated and transformed in large time-shared computers and transmitted to c.r.t. for display. The display terminals range from inexpensive character display terminals through 10K storage tube terminals to fast dynamic displays with a local computer such as IBM 2250 display and IBM 1130 or IBM 1800 computer. The NRC system with a stand-alone medium sized computer is not typical.

Hardware for display of 2D projection of 3D images and rotation of images is available either as analog gear (Adage) or digital (Evans/Sutherland) costing $150 to $200 K. The NRC system employs vector hardware and 3D and rotation software for these tasks.

Efforts are in progress in several places to develop interactive graphics in raster displays using TV monitors. Stanford Research Institute uses standard TV format and an analog scan conversion system. IBM and Rand Corporation are developing raster systems using high resolution (875 line) TV monitors and a special vidicon for scan conversion.

Computer driven displays of the simplest type are used primarily as input/output devices for time-sharing systems and handle alpha-numeric data. Storage tube terminals have only recently become available and are used for test editing. NRC will be investigating CPM/PERT analysis on a storage tube terminal. The more dynamic displays are applied in circuit design and analysis, simulation, modeling mechanical and engineering design and architecture. At NRC work has been concentrated on means of communicating efficiently with a computer for non-programming users such as researchers, animators and musicians.

The problems arising from the status quo are:

(a) cost -- computer driven displays of all degrees of complexity are too expensive for many potential users. This is particularly true of dynamic displays which have the greatest potential in interactive and creative applications.

(b) capabilities (e.g., reproduction of surfaces are not yet fully developed. Improvements in both hardware and software are needed. The use of raster scan format for transmission and display of computer generated graphical information is likely to increase because of the availability of proven hardware (television, facsimile). Furthermore, the use of raster scan will likely lead to an economical way of representing surfaces, one of the major problems in computer graphics.

2. Current requirements (in Canada) for transfer of visual data from c.r.t. displays by communications systems are met by dial-up telephone lines or dedicated lines. Dynamic displays have not reached the state of development and use to need broadband communications between them. Transmission of static visual data such as computer generated drawings or computer stored graphs, tables, catalog information, could take place over dial-up lines, but use is not yet common.

In the U.S.A. the Advanced Research Project Agency is sponsoring a project for interconnecting large computers in major research centres such as Stanford, M.I.T., Harvard, Illinois, Utah, Rand Corp. into a network of dissimilar computers forming a resource sharing distributed utility. Problem areas here are the message processors that are needed for a multi-point, high capacity fast response communications system. The establishment of sufficient compatibility between dissimilar centres is also a major difficulty.

3. Future communications requirements are almost certain to include a resource sharing network of the kind supported by ARPA linking all major centres in Canada.

A greatly expanded network of dial-up data links for data (including visual data), transmission for many kinds of visual information systems, library, technical and catalog information, business information, artistic and cultural information and educational information.

4. The major new service in visual data transmission that we foresee in the next decade is a resource sharing network like that supported by ARPA. Even so, only interchange or sharing of static data will take place at first. Eventually interchange of dynamic visual information between selected users will be required.

Computer generated or computer processed visual data will be more and more common in data banks. Facilities for retrieval and transmission, as contrasted to sharing will be needed. These needs, however, can be met by extension of existing dial-up and dedicated telephone lines and should not need a new service.

5. Social effects of increasing utilization of visual information communication systems of the kind to which we have limited our discussion will be small in comparison with the effects of say television. Even at the end of the next decade utilization will not be widespread. There will be an increase in productivity in some creative activities: more effective engineering and research, richer more interesting artistic output, greater availibility or retrievability of many kinds of visual information for education and business or government administration.